

DOCUMENT RESUME

ED 045 445

SE 010 443

AUTHOR Pratt, Harry D.; Stojanovich, Chester J.
TITLE Workbook on the Identification of Anopheles Adults.
Preliminary Issue.
INSTITUTION National Communicable Disease Center (DHEW),
Atlanta, Ga.
PUB DATE 66
NOTE 59p.
EDRS PRICE MF-\$0.50 HC-\$3.05
DESCRIPTORS Autoinstructional Aids, *Biology, Entomology,
*Health Occupations Education, *Instructional
Materials, *Programed Materials, Public Health,
*Taxonomy

ABSTRACT

This self-instructional workbook is designed to enable malaria control workers to identify adults of "Anopheles" species that are important malaria vectors. The morphological features of the adults are illustrated in a programed booklet, which also contains an illustrated taxonomic key to adult females of 20 anopheline species. A glossary and a short bibliography are included.
(AL)

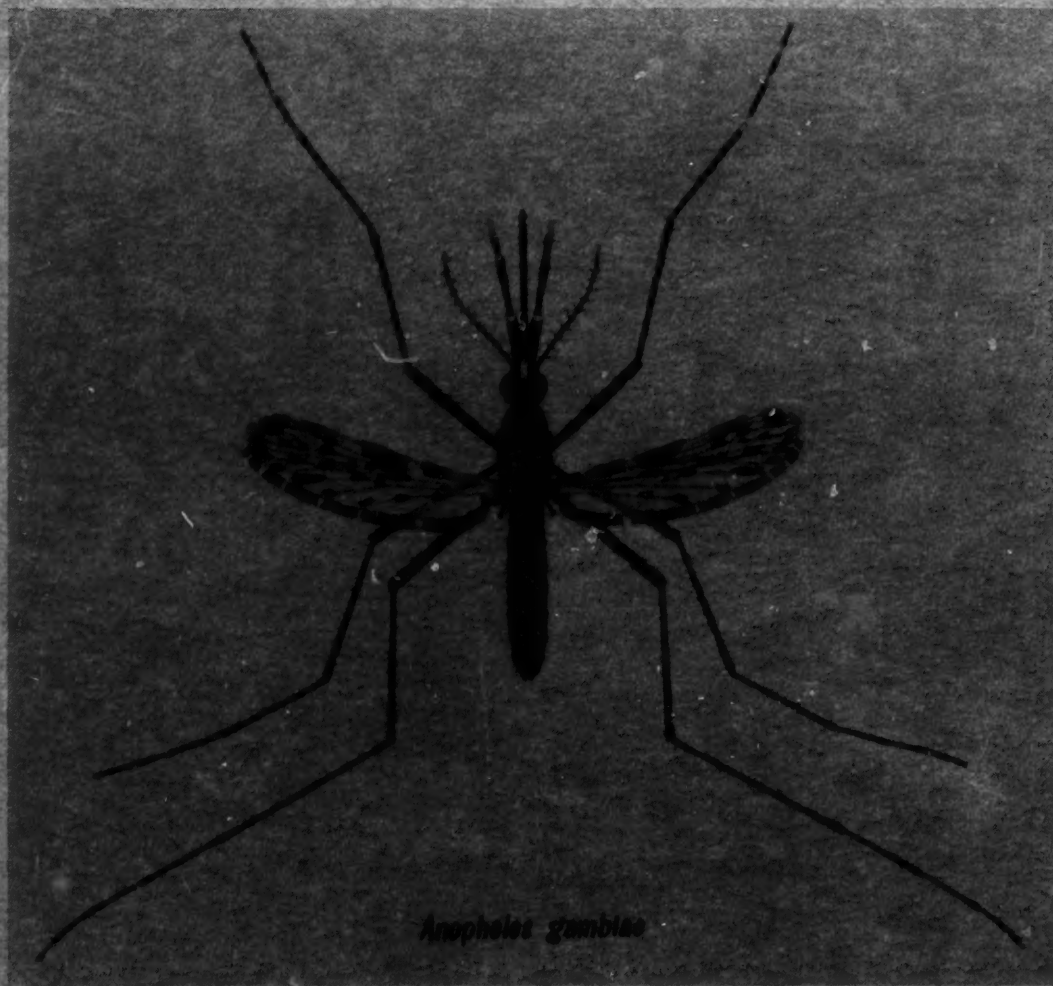
ED0 45445

Preliminary Issue

WORKBOOK ON THE IDENTIFICATION OF ANOPHELES ADULTS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE
PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS
STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION
POSITION OR POLICY.



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

SE 010 443

ED0 45445

**WORKBOOK ON THE IDENTIFICATION
OF ANOPHELES ADULTS**

**Harry D. Pratt
and
Chester J. Stojanovich**

1966

**U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
Communicable Disease Center
Atlanta, Georgia 30333**

INTRODUCTION

One of the most important aspects of the worldwide malaria eradication program is the accurate determination of the species of Anopheles mosquitoes actually involved in transmitting the disease. The decision in a particular area to use residual spraying of buildings, larviciding, or drug administration to achieve malaria eradication should be determined by such factors as: man-biting or animal-feeding habits of the adult Anopheles, outdoor or indoor feeding habits of the vector mosquitoes, tendency for adult female Anopheles to rest on sprayed walls after a blood meal, and the occurrence of larval breeding places, which can be larvicided more efficiently than houses can be treated by residual spraying. The accurate determination of the species of Anopheles mosquitoes is obviously of utmost importance in making such an assessment.

HOW TO USE THIS BOOKLET

The purpose of this self-instructional workbook is to teach, not to test. It has been specially written so that you can learn by doing. Parts I and II can be completed with pencil, each student setting his own pace, taking whatever time is necessary. Read each page carefully. Write in the answers as you work through the workbook and compare your answers with those in the answer book.

REMEMBER

- Read EVERYTHING carefully, more so than you ordinarily do
- Work through each paragraph and page ONE STEP AT A TIME
- Do your best to answer all the questions BEFORE you look back or use the answer book.

When you have completed Parts I and II, use a microscope and the illustrated key in Part III to identify specimen mosquitoes, which your instructor will provide.

PART I

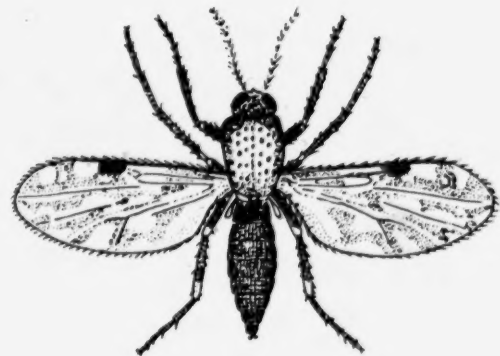
What is an Anopheles Adult?

Mosquitoes belong to the Order Diptera--the large group of insects with only two wings--hence the scientific name Di+pteron
two wings.

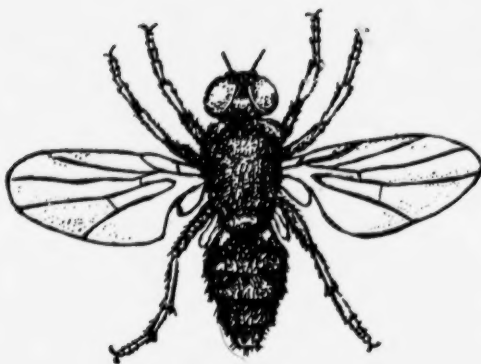
This order includes the mosquitoes, midges, gnats, and true flies.



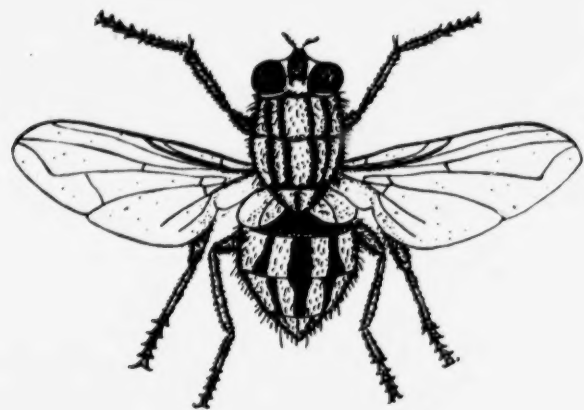
MOSQUITO



MIDGE

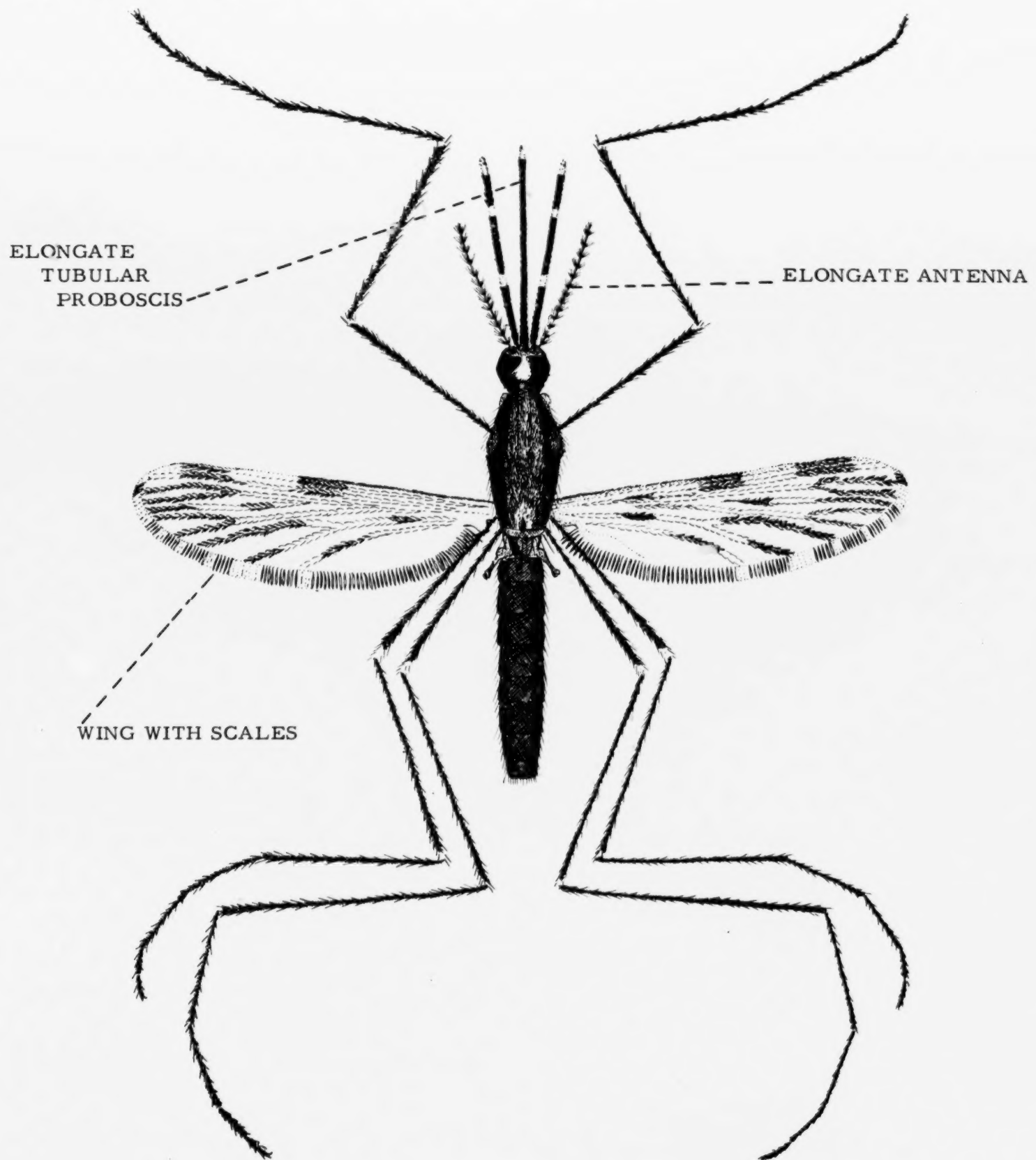


GNAT

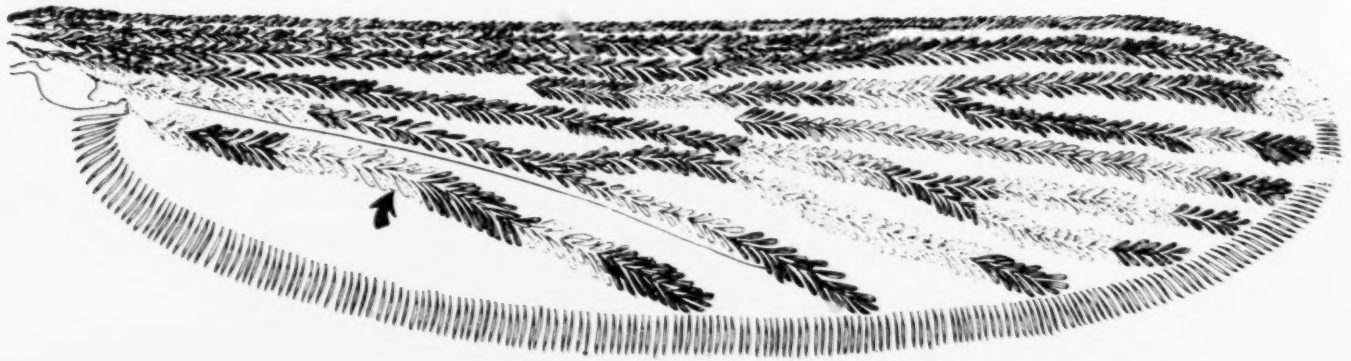


TRUE FLY

Within the Order Diptera the mosquitoes are placed in a single family Culicidae easily recognized by a number of characteristics: wing veins and hind margin with scales, an elongate tubular proboscis adapted for sucking fluids, and an elongate antenna.



Close-up views of these three parts are shown below,

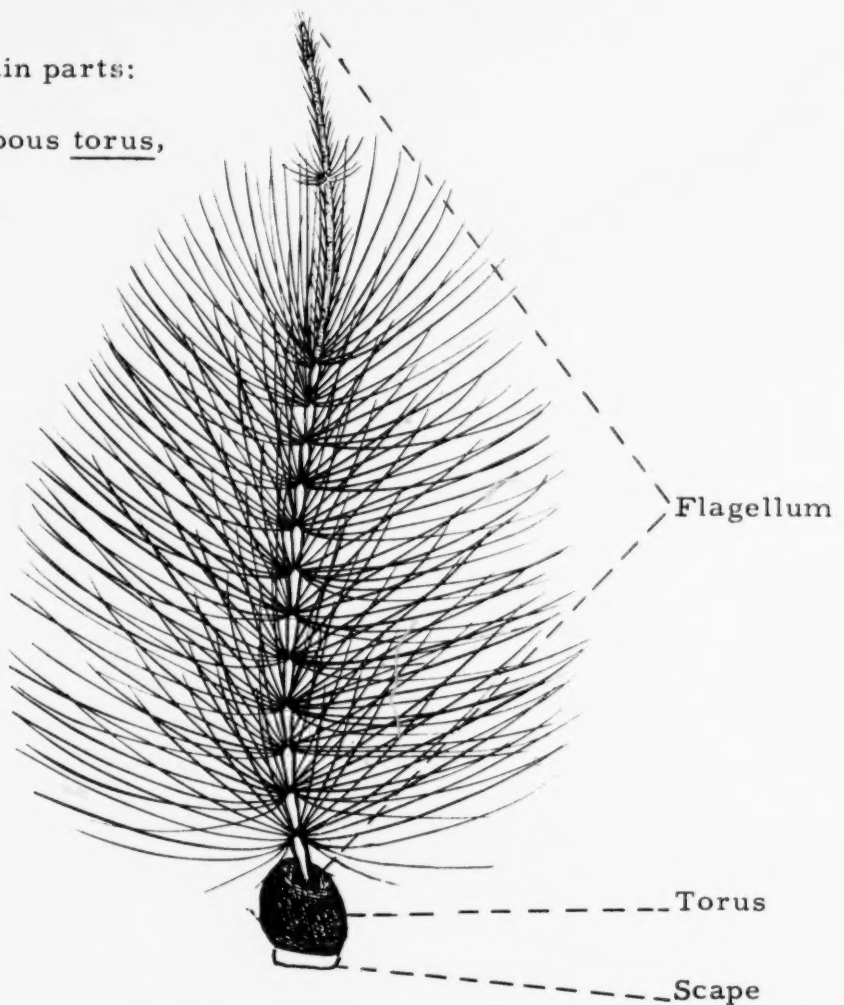


WING WITH SCALES



TUBULAR PROBOSCIS

The antenna is composed of 3 main parts:
a small basal scape, a large bulbous torus,
and a many segmented flagellum.

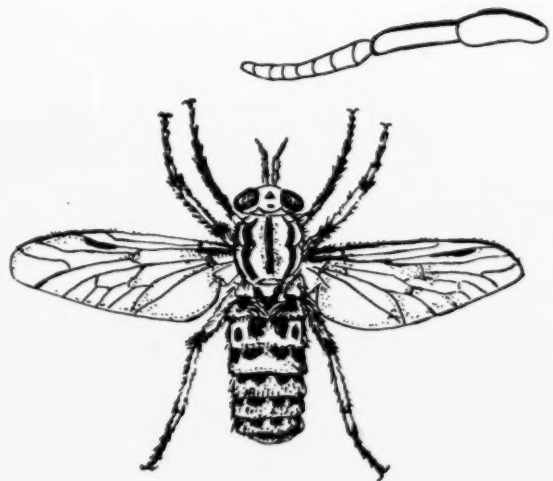


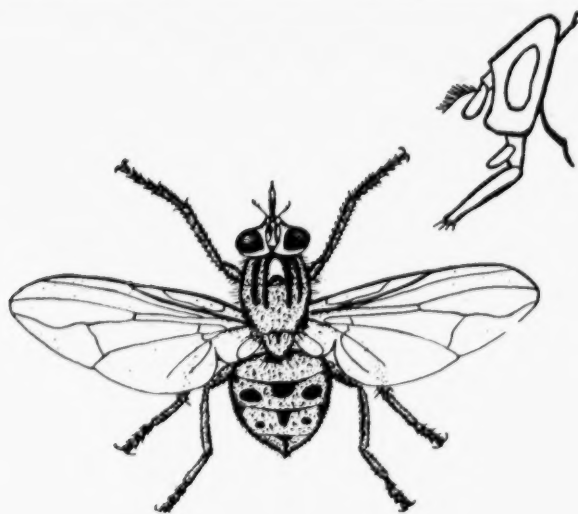
ELONGATE ANTENNA

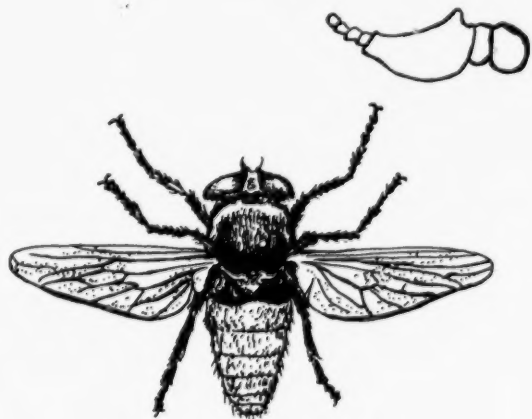
These blood-sucking flies are not mosquitoes. In a few words, write below each drawing the reasons why you think these insects are not mosquitoes.



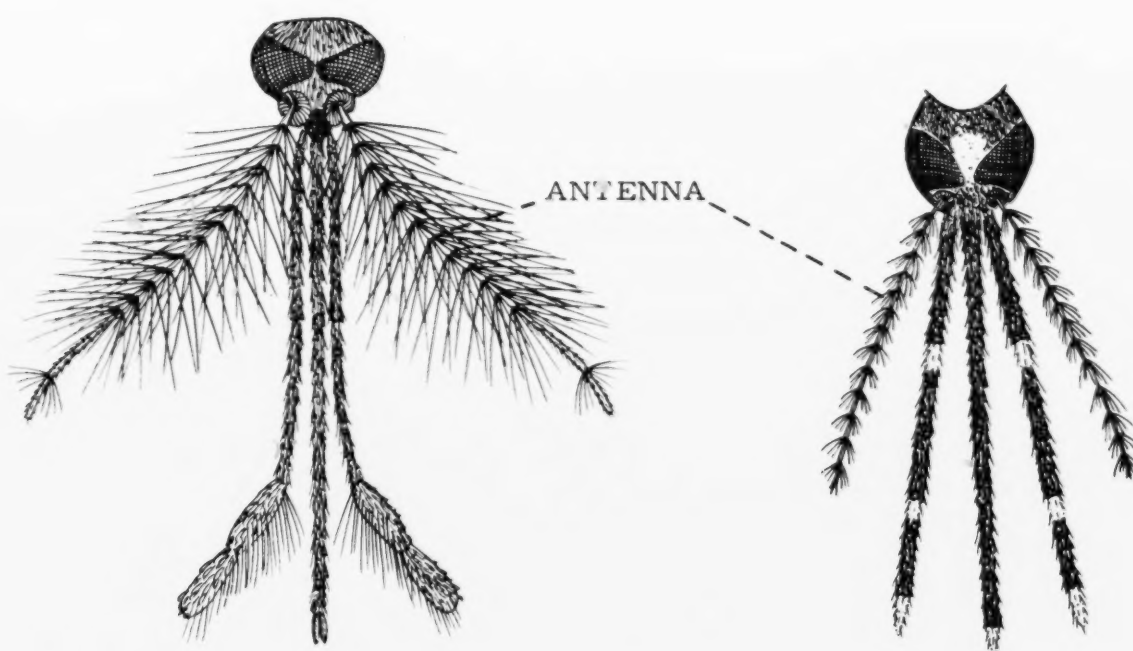
No scales on wings;
no elongate tubular
proboscis







The sex of mosquitoes enters into identification. Male mosquitoes can be distinguished from female mosquitoes by two characters -- the antennae and the abdomen. The antennae of most males usually have much longer hairs than those of the females; and the male abdomen ends in a pincer-shaped structure for holding the female during mating.



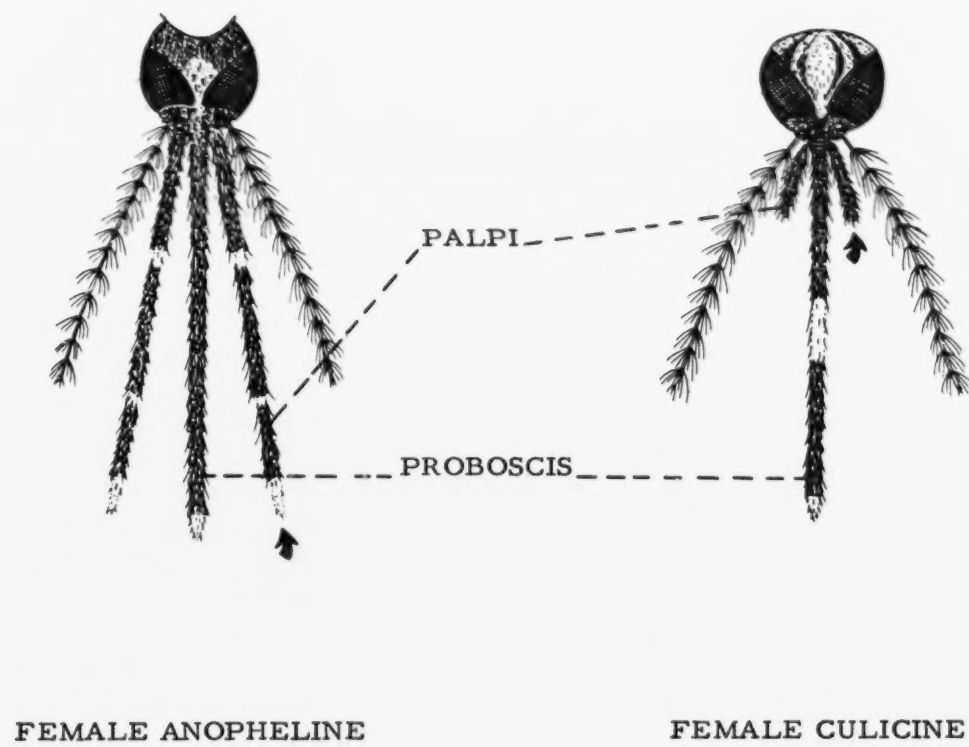
MALE

FEMALE

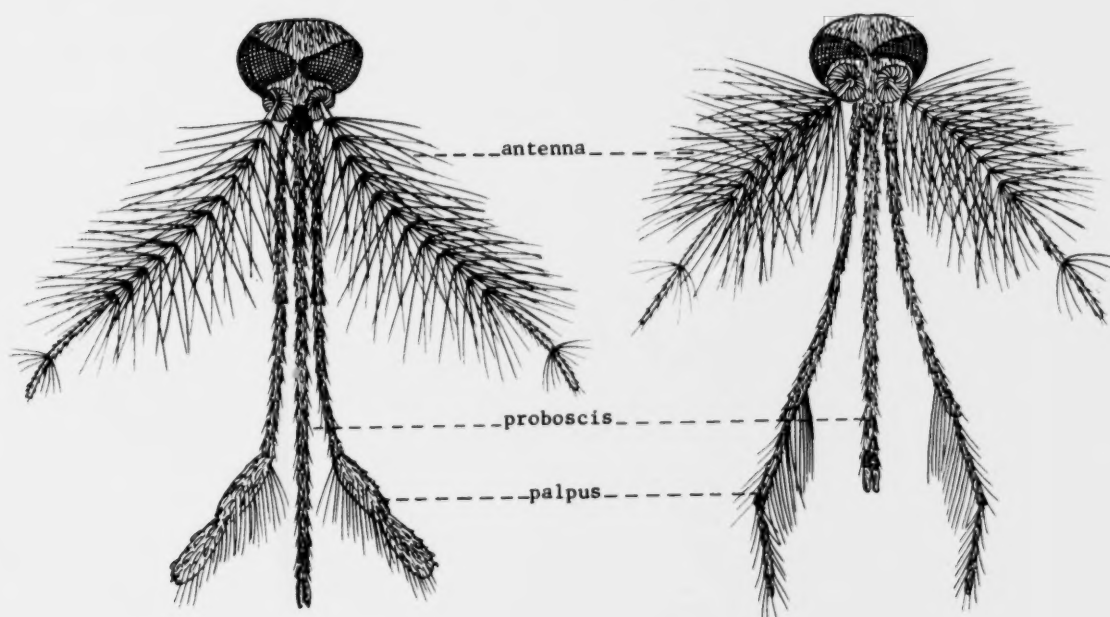


MALE ABDOMEN

There are two large groups of mosquitoes: the anophelines and the culicines. In general, female anophelines have the palpi about as long as the proboscis, while female culicines have the palpi shorter than the proboscis, often much shorter.



In general, male anophelines have the palpi enlarged at the tip, often referred to as "club-shaped or spoon-shaped", while the palpi of male culicines most frequently taper to a point. In many species of culicines, the male palpi are distinctly longer than the proboscis.



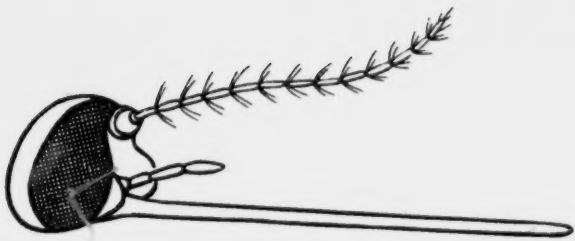
HEAD OF ANOPHELINE MALE

HEAD OF CULICINE MALE

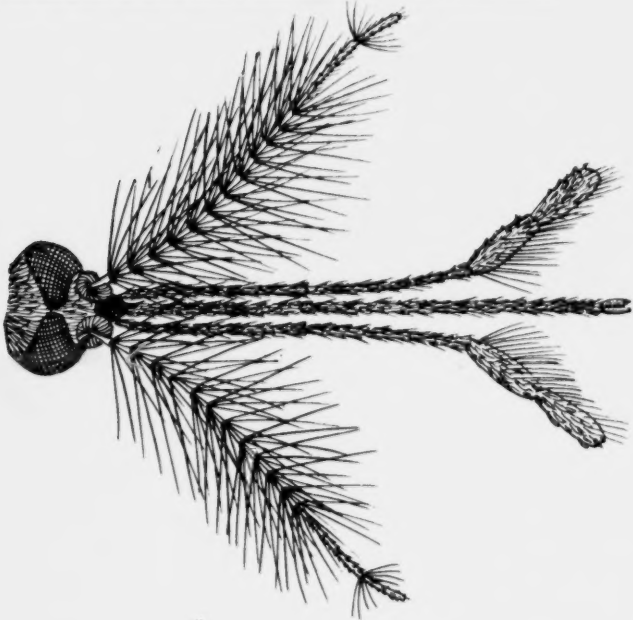
TEST YOURSELF: Write one of the four terms beneath each drawing.

1. Male Culicine
2. Male Anopheline

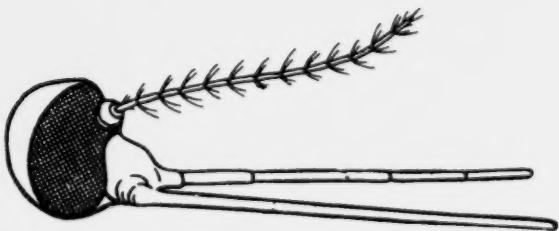
3. Female Culicine
4. Female Anopheline



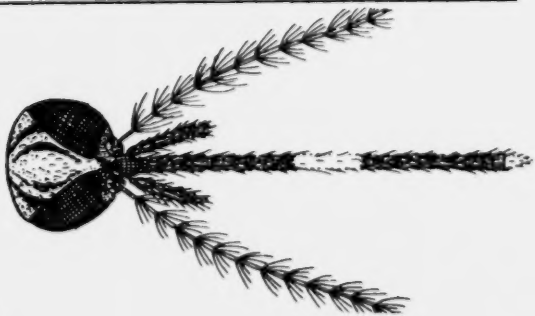
A Female culicine



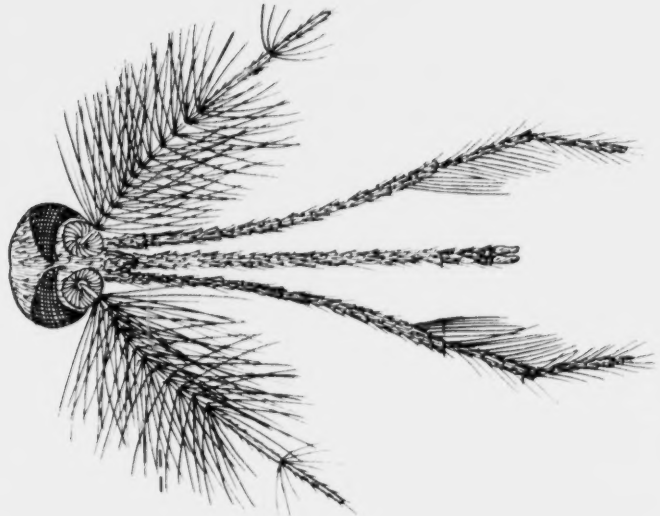
B



C



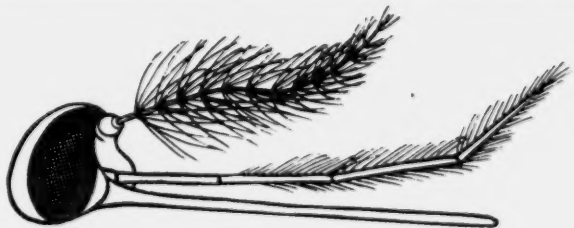
D



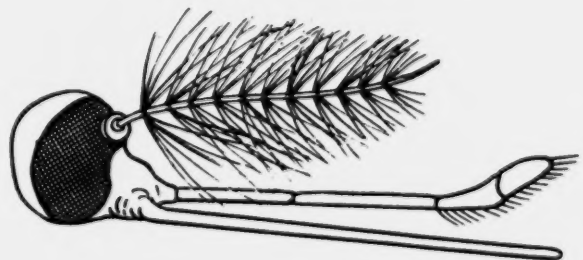
E



F

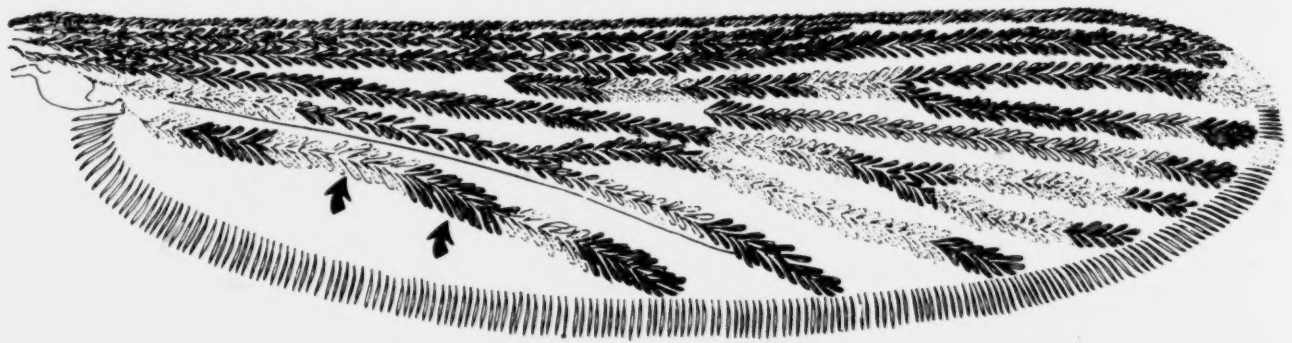


G

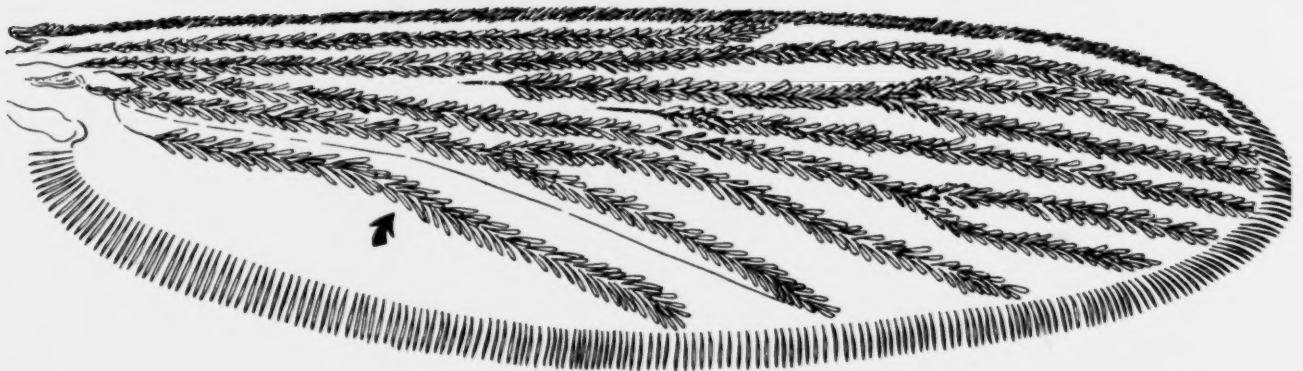


H

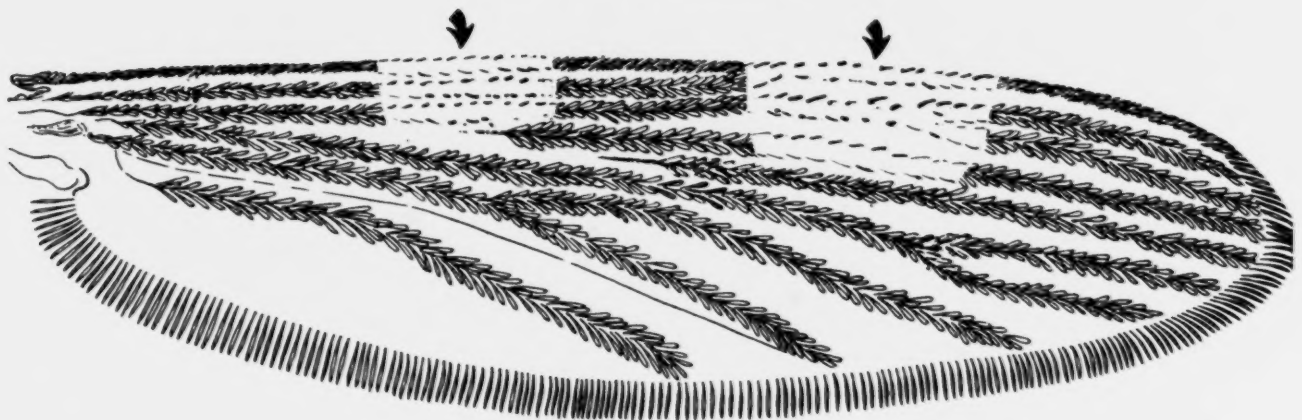
Typical Anopheles are easily recognized by their wings which appear spotted due to a clumping of dark or light-colored scales, while typical culicines have clear wings. However, there are exceptions to this statement: a few Anopheles have clear wings, as Anopheles culiciformis or Anopheles barberi, while a few culicines have spotted wings, as Culex mimeticus or Culex mimulus.



ANOPHELES

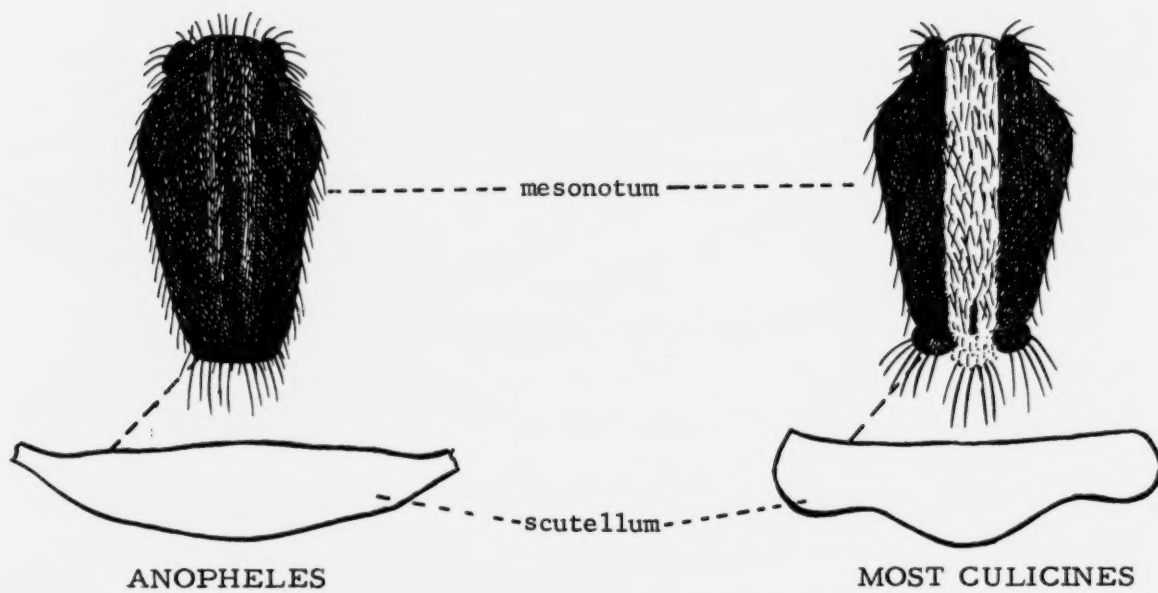


ANOPHELES BARBERI



CULEX MIMULUS

The main top part of the thorax is called the mesonotum. A shorter plate behind the mesonotum, the scutellum, is of major importance in separating the mosquitoes into two groups. The scutellum is strap-like in Anopheles and trilobed in culicines.



The abdomen in most anophelines has no scales on the dorsal (upper) surface while in many culicines there is a conspicuous covering of scales.



ANOPHELES



CULICINES

IN SUMMARY

Mosquitoes in the genus Anopheles can be recognized by the following characteristics:

In the female, the palpus is _____ the proboscis.

In the male, the palpus is _____-shaped.

The wings are usually _____.

The scutellum is _____-like.

The abdomen is _____.

Culicine mosquitoes can be recognized by the following characteristics:

In the female, the palpus is _____ than the proboscis.

In the male, the palpus is _____.

The wings are usually _____.

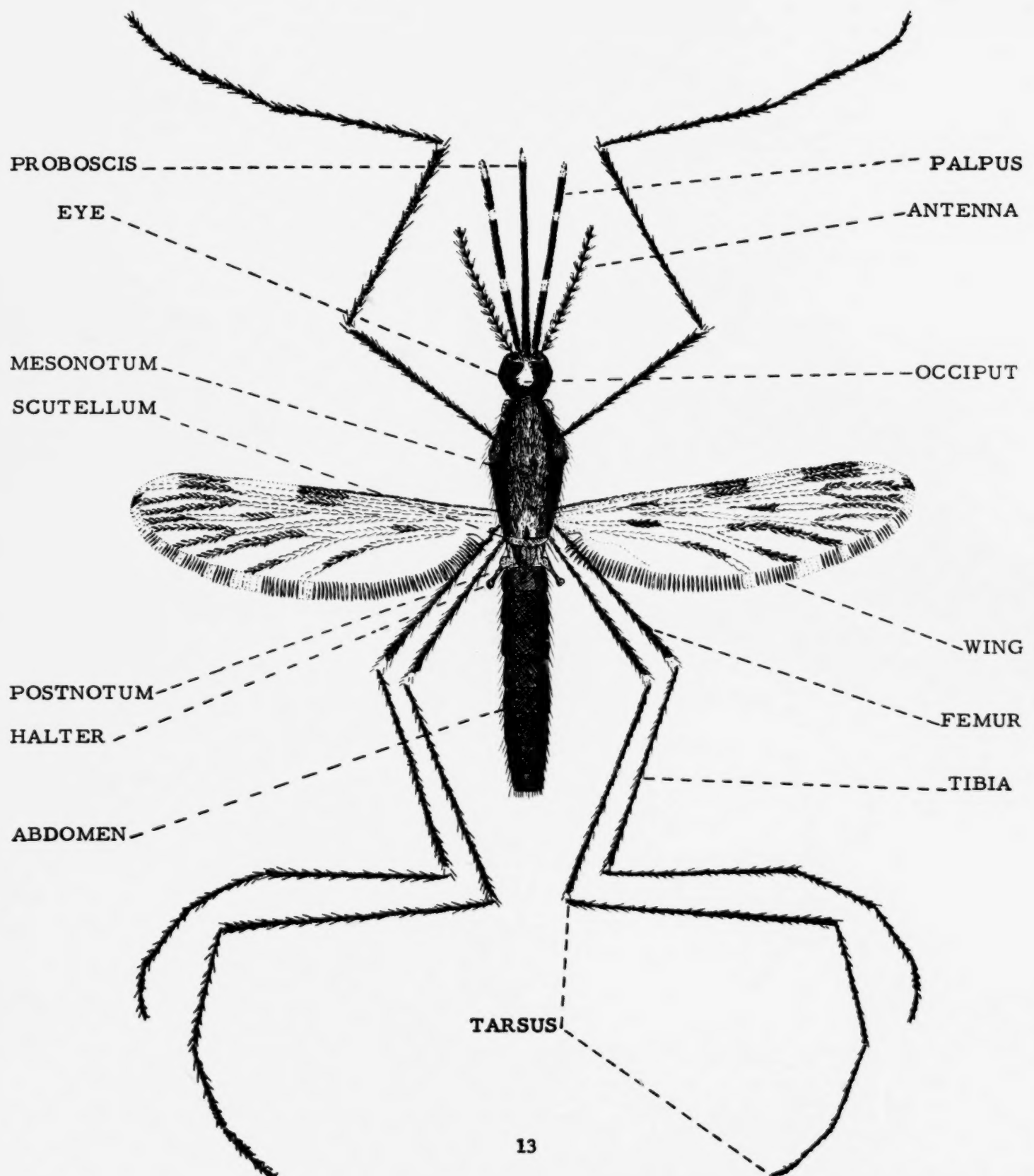
The scutellum is _____.

The abdomen is usually covered with _____.

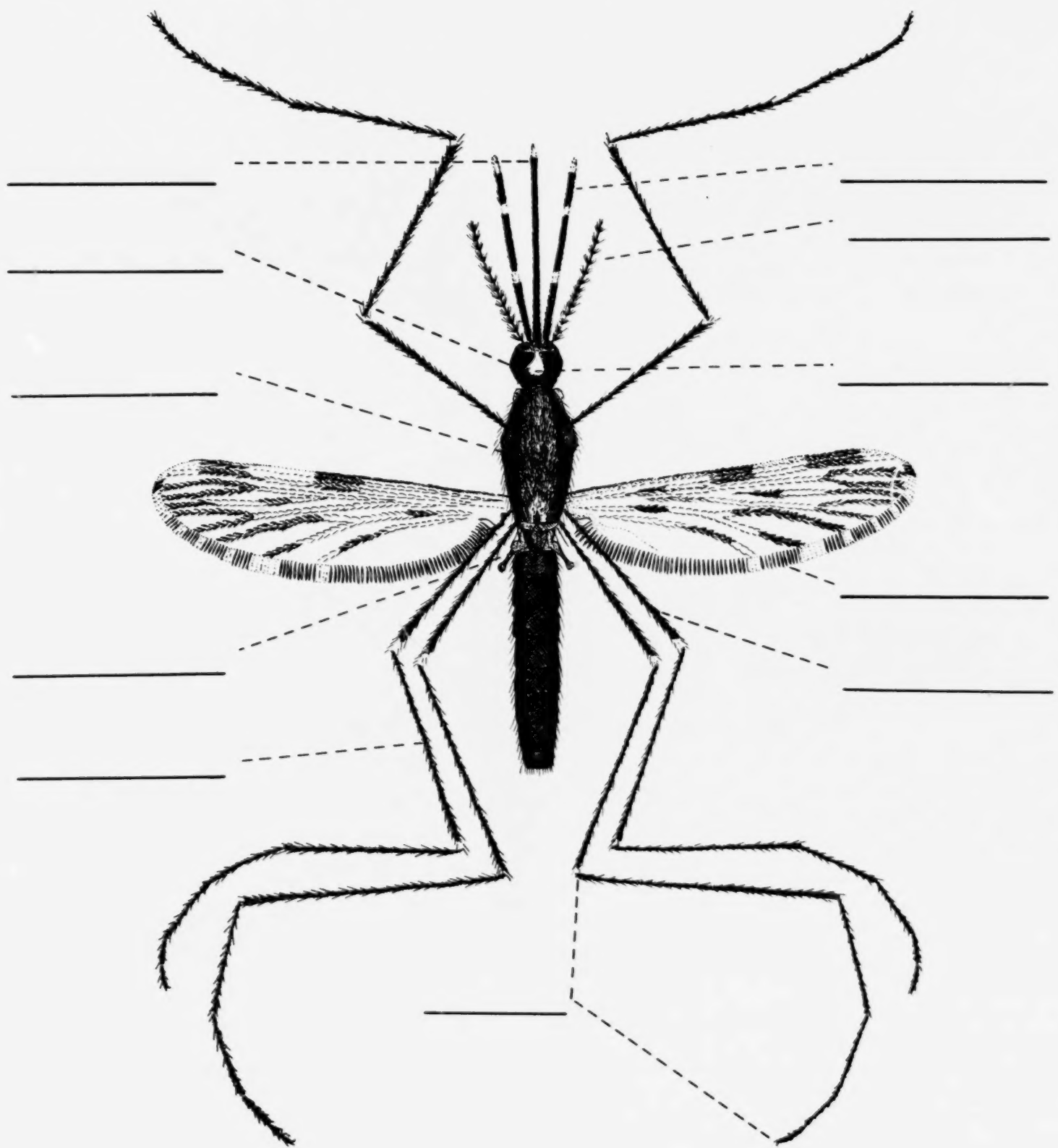
PART II

Morphology of Anopheles Adults

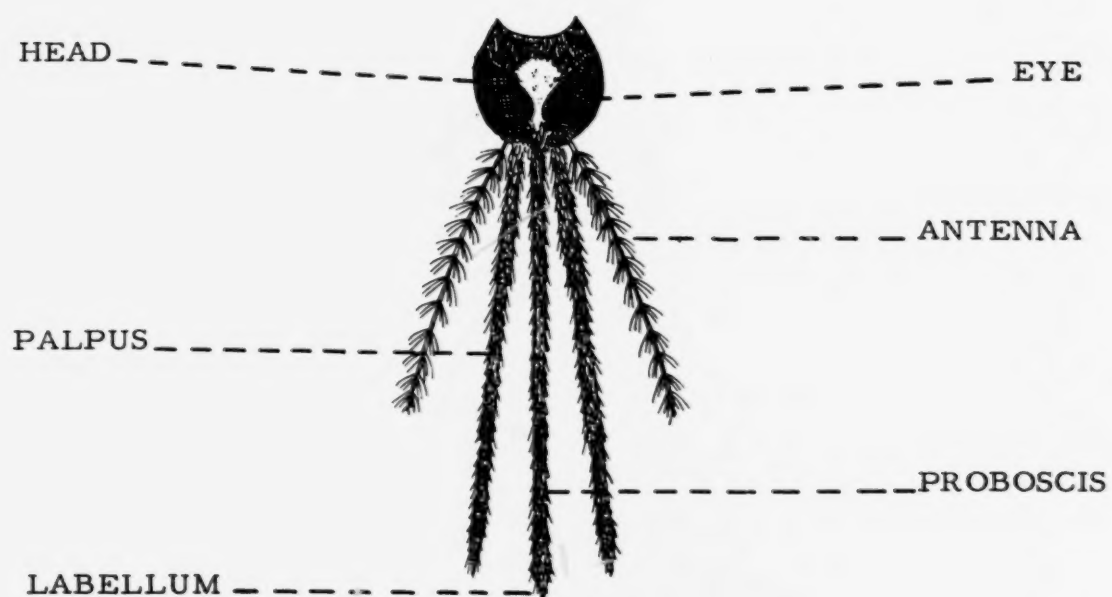
The coloration and form of many parts of the mosquito body are used in identification. Study the names of these parts carefully until you know them all.



Now write the names of the parts of the mosquito body on the lines provided:



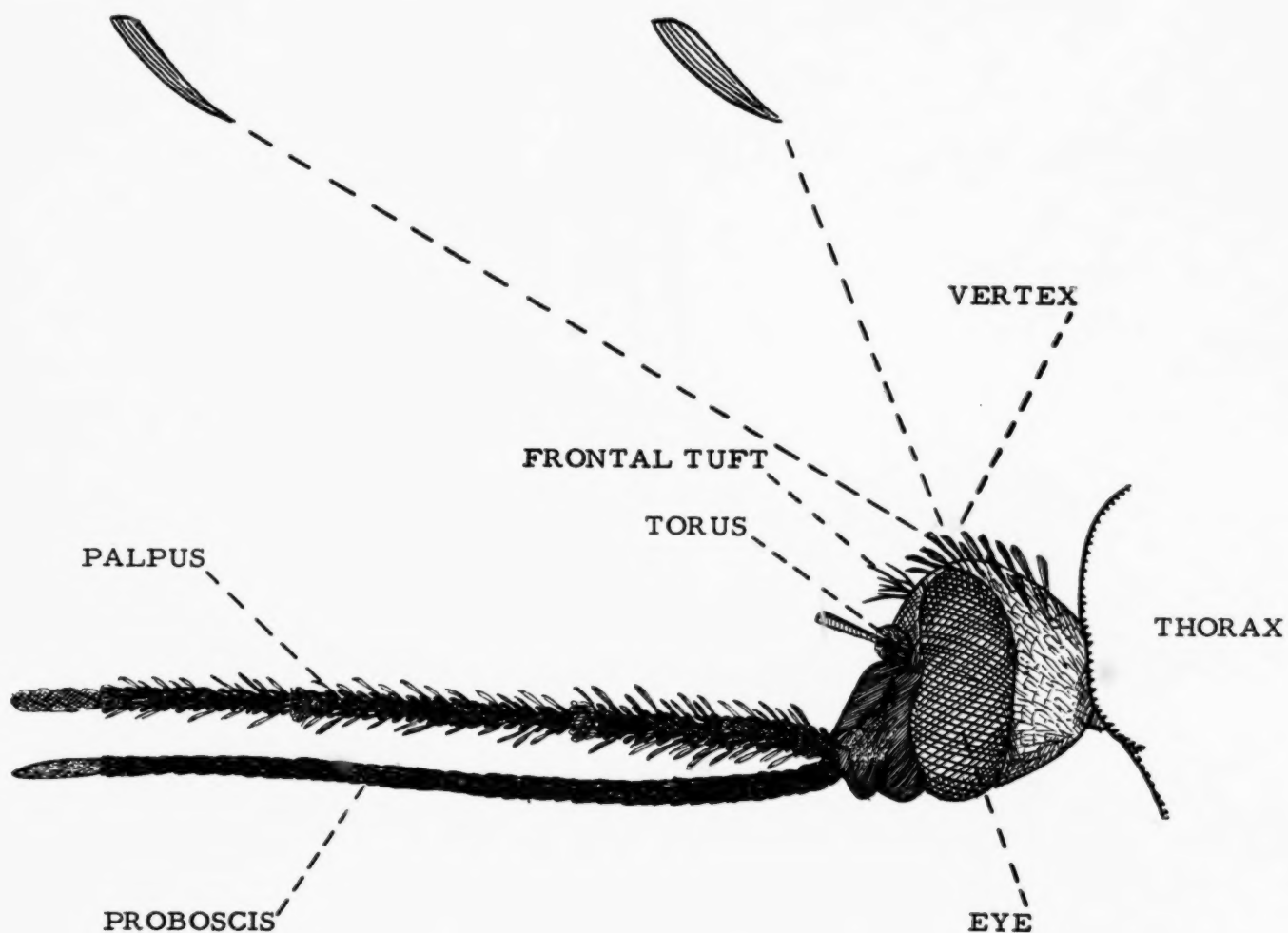
The head bears the proboscis, two antennae (singular, antenna), two palpi (singular, palpus) and the two eyes. The tip of the proboscis is called the labellum.



The upper (dorsal) surface of the head behind the eyes is called the vertex. The shape of the scales on the vertex is a character used in identifying some species.

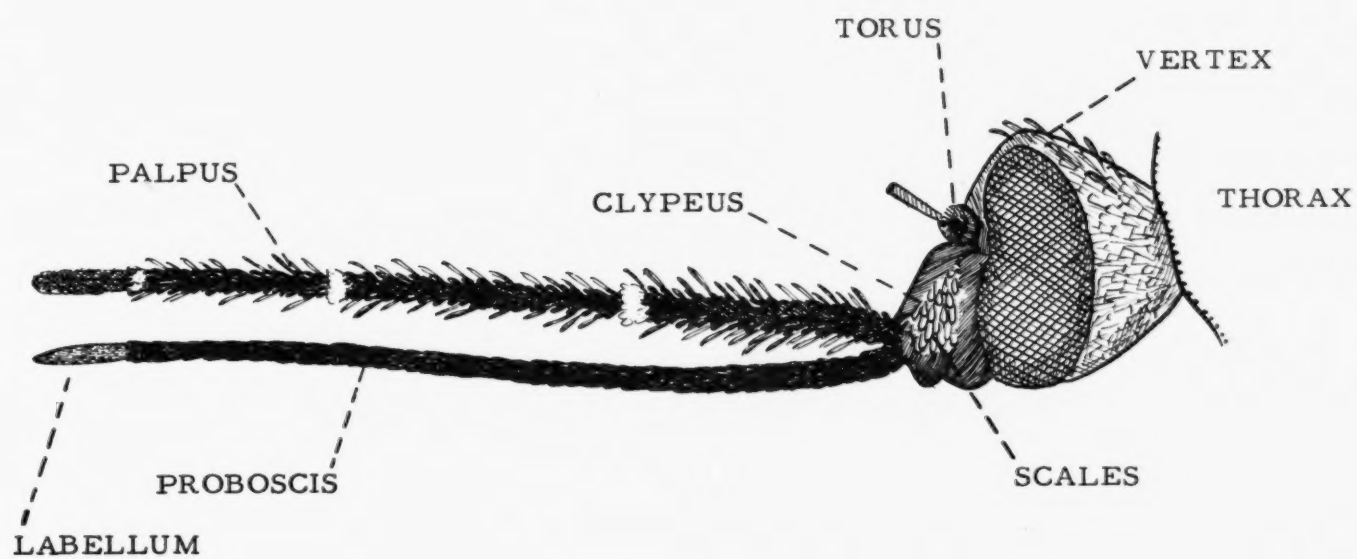
ANOPHELES INSULAEFLORUM
THE SCALES ARE NARROW

ANOPHELES SINTONOIDES
THE SCALES ARE BROAD



A number of species have a frontal tuft of elongate bristles on the top of the head between the eyes. The color of scales or bristles in this frontal tuft is used in identification.

The clypeus is located on the anterior surface of the head and forms the base for the palpi and proboscis. In some species, as in Anopheles hyrcanus, there are tufts of scales on each side of the clypeus.



In most species the proboscis is entirely dark scaled. However, in a few important species, such as Anopheles minimus, the tip is pale and in others, as Anopheles acon tus, the outer part is pale.



ANOPHELES MINIMUS



ANOPHELES ACONITUS

The palpus consists of five segments. The relative length of the segments is used in separating a few species.

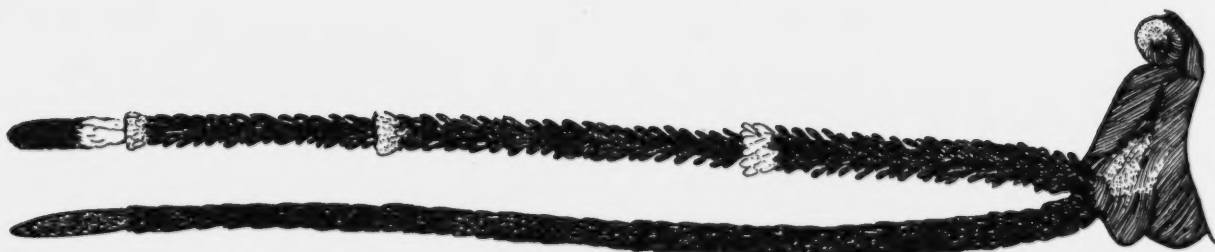


For example, the European species Anopheles claviger has the fifth segment of the female palpus less than half as long as the fourth while the A. plumbeus has the fifth segment more than half as long as the fourth.

Normally the palpi are covered with fine scales, but some species, such as Anopheles coustani and Anopheles barbirostris, have much longer scales which give the palpi a shaggy appearance and furnish useful identification characters.



The color pattern of the palpus is of great importance in species identification. The palpus is entirely dark in some species; in others it is pale-banded. Some species have the last segment entirely white, while others have the last segment white with a dark tip. The relative widths of the pale or dark bands are also used in identifying species.



TEST YOURSELF: Match one of the numbered statements with one of the lettered drawings.

1. Palpus is entirely dark.

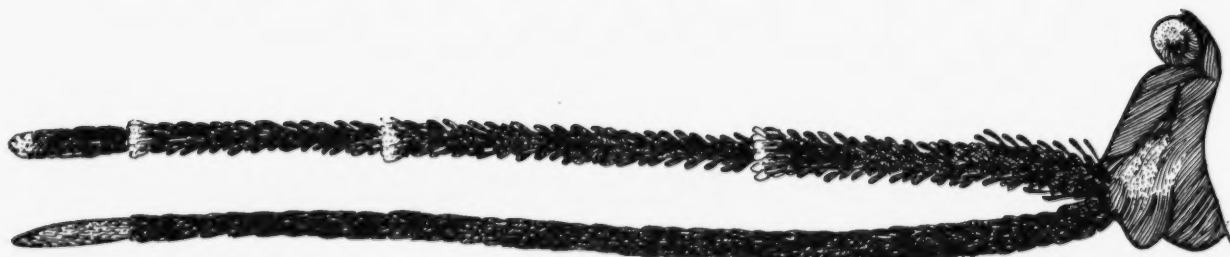
2. Palpus has 4 faint apical bands.

3. Palpus has 2 broad and 1 narrow white bands.

4. Palpus has pale bands at the base and apex of the segments, hence appears to have 3 pale bands



A _____



B _____



C _____



D _____

TEST YOURSELF: Match one of the numbered statements with one of the lettered drawings.

1. Palpus has prominent pale and dark bands but a dark tip.

3. Palpus has 1 broad and 2 narrow white bands.

2. Palpus has prominent pale and dark bands and the last segment entirely pale.

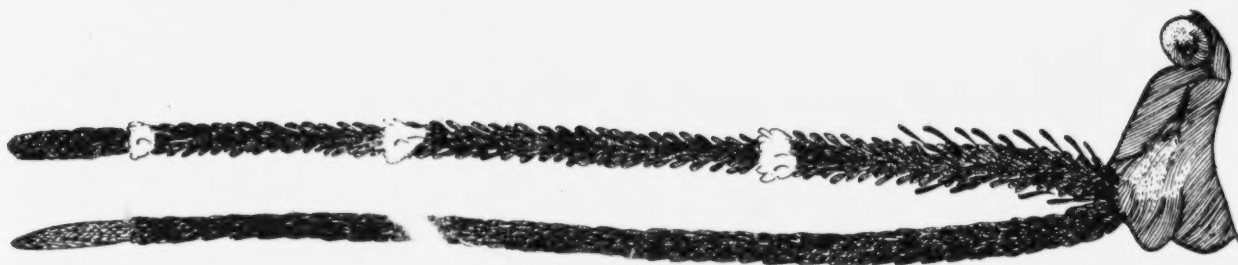
4. Palpus is entirely dark except for the last segment which is entirely pale.



A _____



B _____

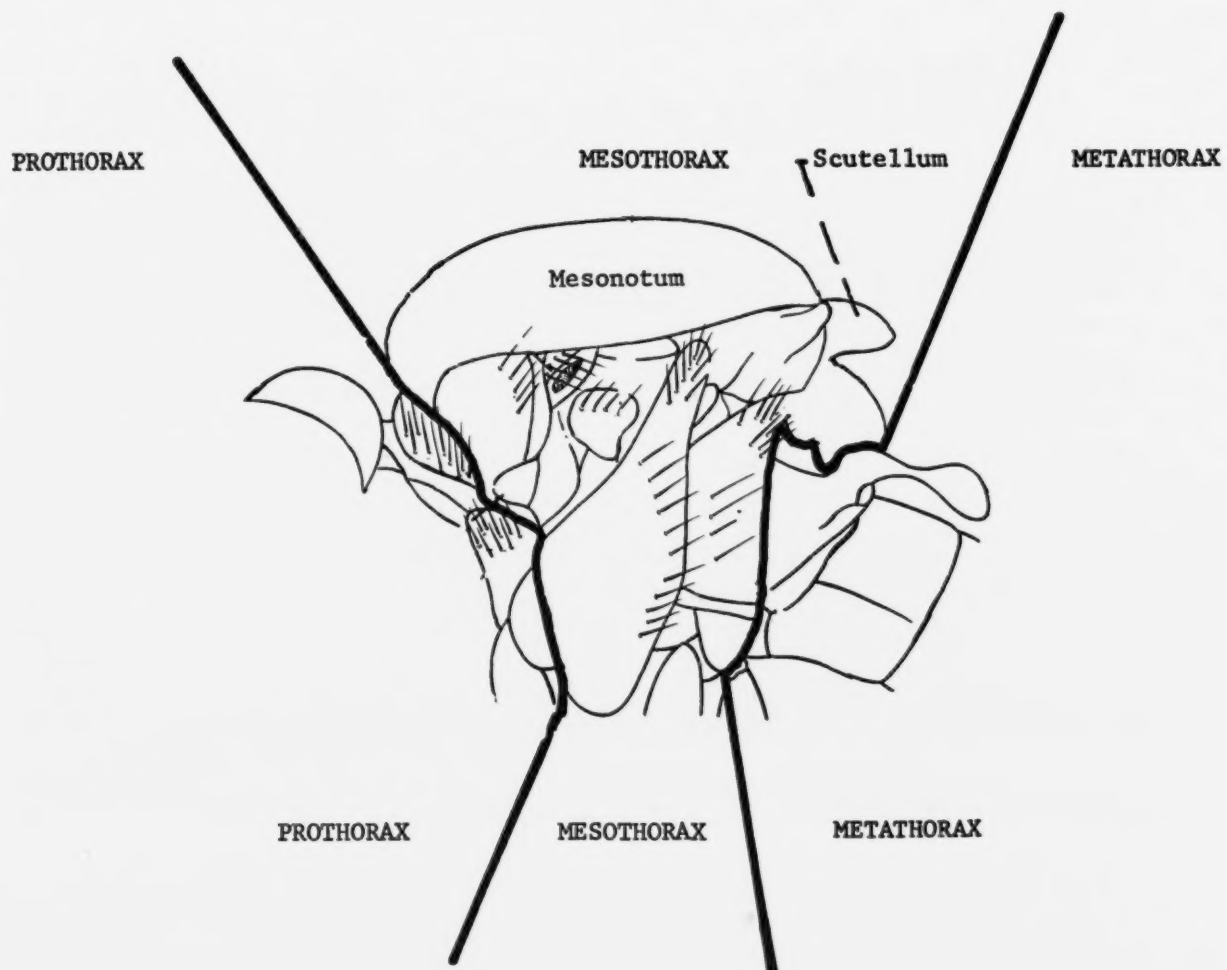


C _____

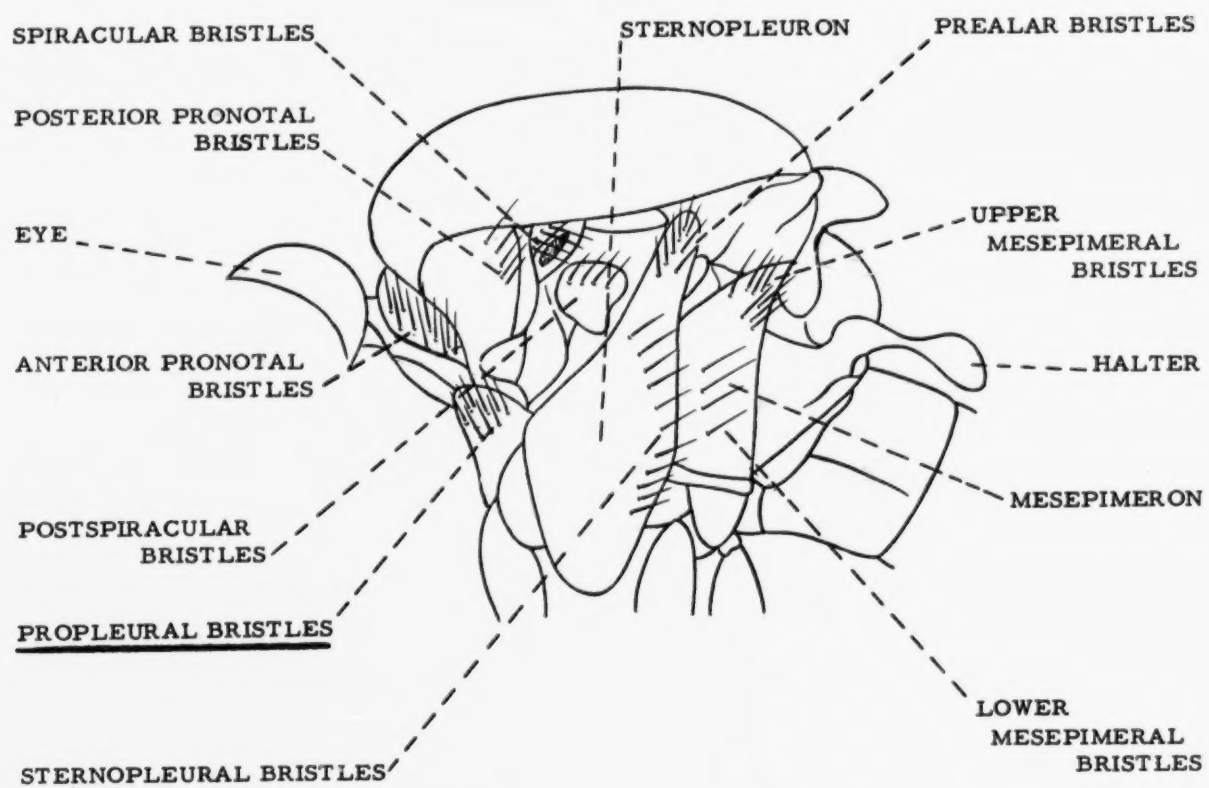


D _____

The thorax is composed of three fused segments called prothorax, mesothorax, and metathorax. The top (or dorsal side) of each of these segments is called the notum (or scutum); the side, the pleuron; and the bottom (or ventral side), the sternum. These terms may be combined in describing a particular plate. Thus, the top of the mesothorax is called the mesonotum. A straplike plate behind the posterior margin of the mesonotum is called the scutellum.

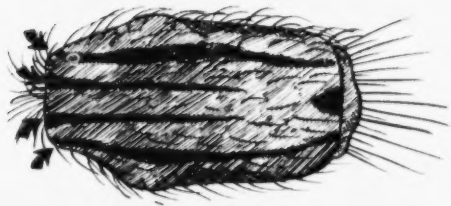


The thorax is made up of many fused plates, often bearing scales and bristles or setae. The arrangement and number of patches of scales and bristles is of great importance in identifying culicine mosquitoes. Some workers use the number of propleural bristles and the scaling of the halter in identifying Anopheles mosquitoes.

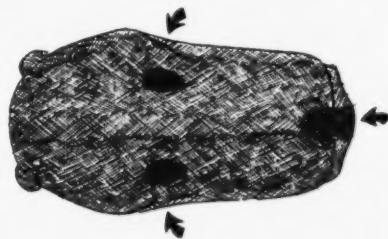


The coloration of the mesonotum furnishes useful identification characteristics. Match one of the numbered statements with a lettered drawing below:

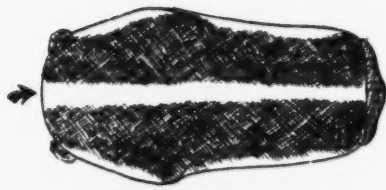
1. The mesonotum is entirely dark in many species, as Anopheles quadrimaculatus.
2. The mesonotum has a broad pale median stripe in Anopheles (Stethomyia), as Anopheles kompi.
3. The mesonotum has 4 dark stripes in the species in the subgenus Anopheles (Kerteszia), as Anopheles bellator.
4. The mesonotum has 3 dark spots in many species in the subgenus Anopheles (Nyssorhynchus), as Anopheles albimanus or Anopheles darlingi.



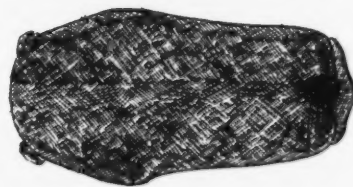
A _____



B _____



C _____

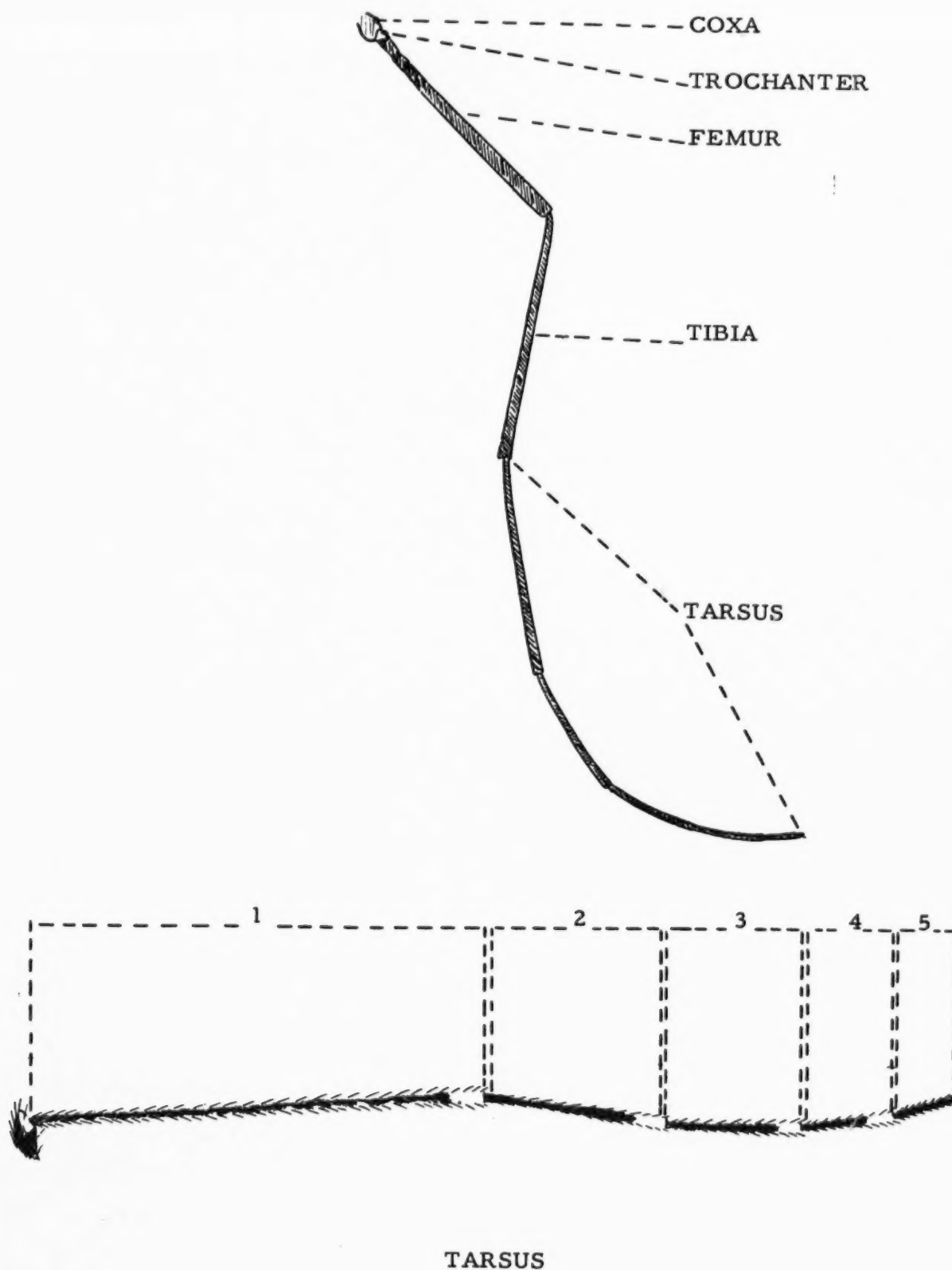


D _____

The arrangement of bristles on the scutellum is used in identifying a number of species.



Legs of mosquitoes, which are important in identification, have five principal parts. Beginning with the one nearest the body, they are called the coxa, the trochanter, the femur, the tibia, and the tarsus. The tarsus is subdivided into five segments.



The coloration of the legs is one of the chief characters used in identifying mosquitoes. Many species of Anopheles (Subgenus Anopheles) have the hind legs entirely dark. Most of the Central and South American species of Anopheles (Subgenus Nyssorhynchus) have the hind tarsal segments 2 to 5 largely or entirely white. Some of the species have white spots at the tip of the femur or tibia and still others have a whole series of white spots on the femur or tibia.



LEGS ENTIRELY DARK

FEMUR AND TIBIA WITH
WHITE TIPS

LEGS WITH SPOTS



TARSUS WITH SEGMENTS 3-5 LARGELY OR ENTIRELY WHITE

The hind femur has patches of very long dark and pale scales in some species such as Anopheles annandalei and Anopheles squamifemur.



ANOPHELES ANNANDALEI



ANOPHELES SQUAMIFEMUR

The hind femur has a broad white band near the middle in Anopheles lindesayi and a conspicuous white spot near the tip in Anopheles gigas.



ANOPHELES LINDESAYI



ANOPHELES GIGAS

TEST YOURSELF: Match one of the numbered statements with one of the lettered drawings.

1. Hind tarsus with segments 1 to 5 entirely dark in Anopheles quadrimaculatus.
2. Hind tarsus with segments 1 to 4 with pale apical rings, 5 entirely dark in Anopheles bellator.
3. Hind tarsus with segments 2 and 5 half dark, 3 and 4 entirely pale in Anopheles aquasalis.
4. Hind tarsus with segments 3 to 5 entirely pale, tip of segment 1 pale in Anopheles albitarsis.
5. Hind tarsus with segments 3 to 5 entirely pale, tip of segment 1 dark in Anopheles argyritarsis.
6. Hind tarsus with segments 1 and 2 speckled in Anopheles punctimacula.



A _____



B _____



C _____



D _____

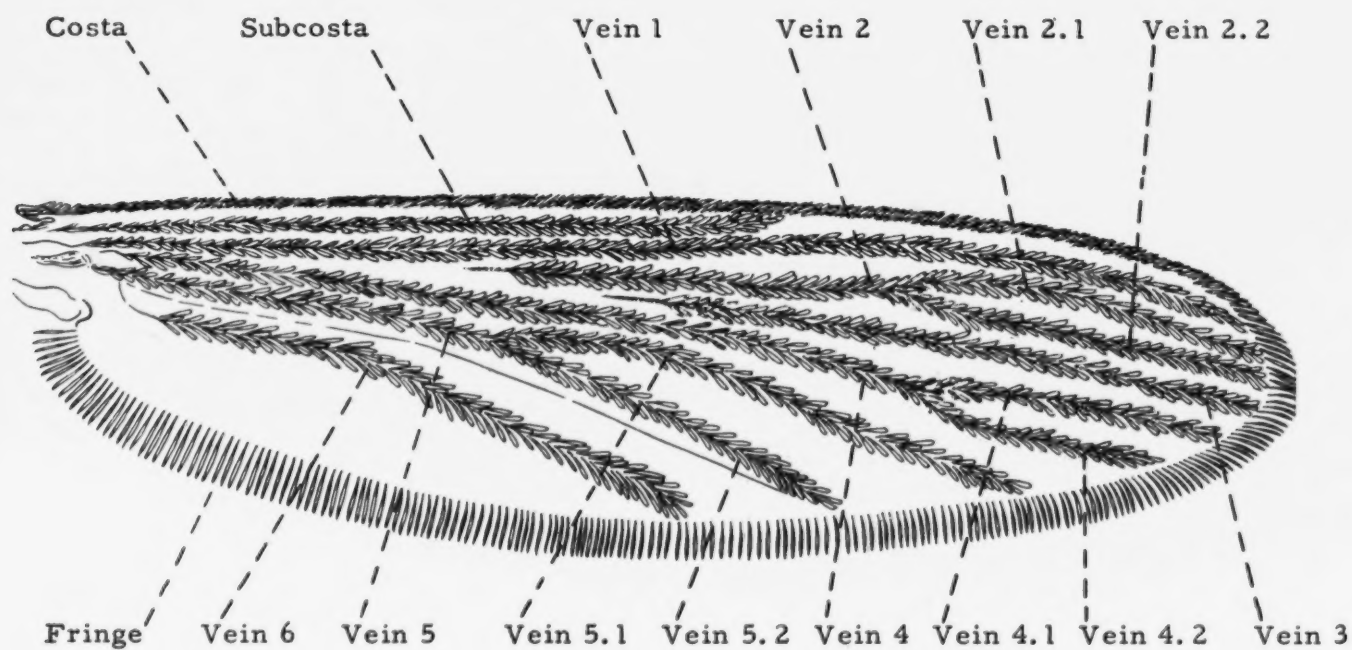


E _____



F _____

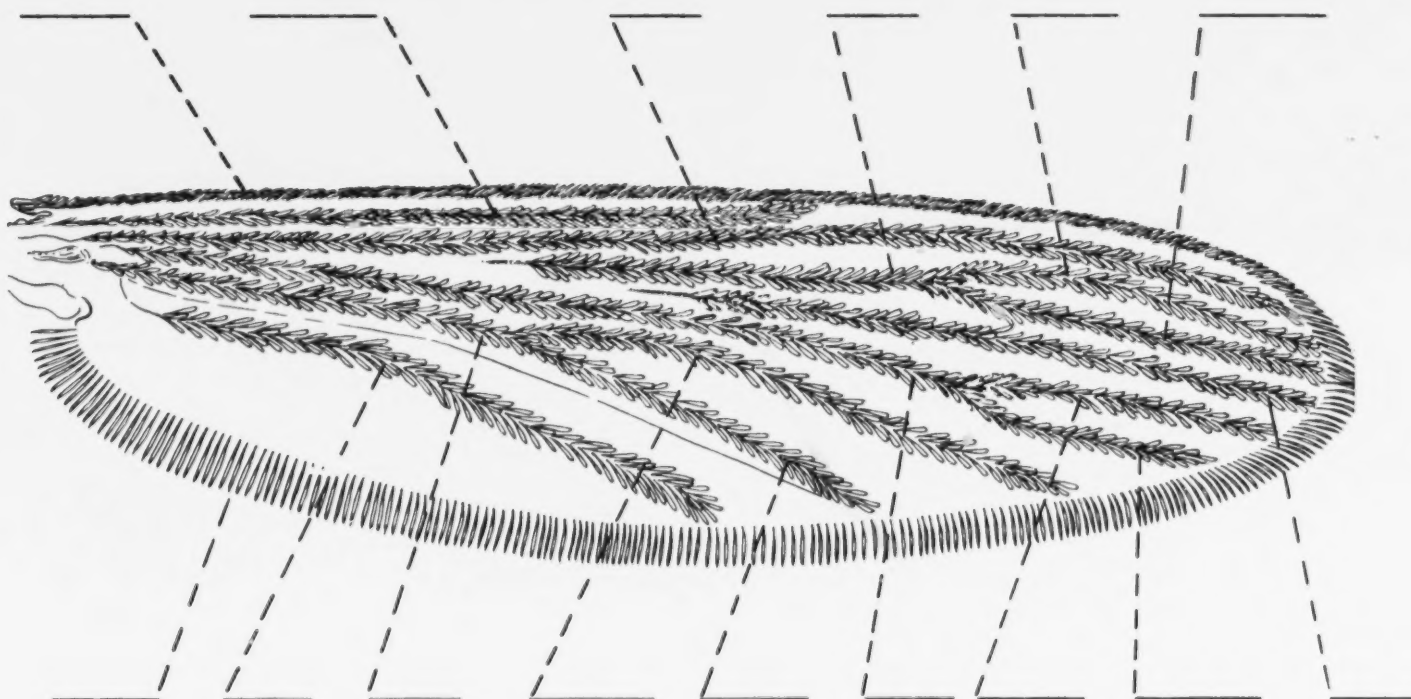
Wings, too, are important in identifying mosquitoes, so study the drawing below very carefully. The anterior edge of the wing is called the costa, and the vein next to it is known as subcosta. Behind these are 6 longitudinal veins numbered 1, 2, 3, 4, 5, 6, of which veins 2, 4, and 5 are branched.



The fringe is a line of scales along the margin of the wing. The color of the wing fringe is used in identifying mosquitoes.

Label the veins in the drawing below.

Which three veins are forked _____



Which three veins are not forked _____

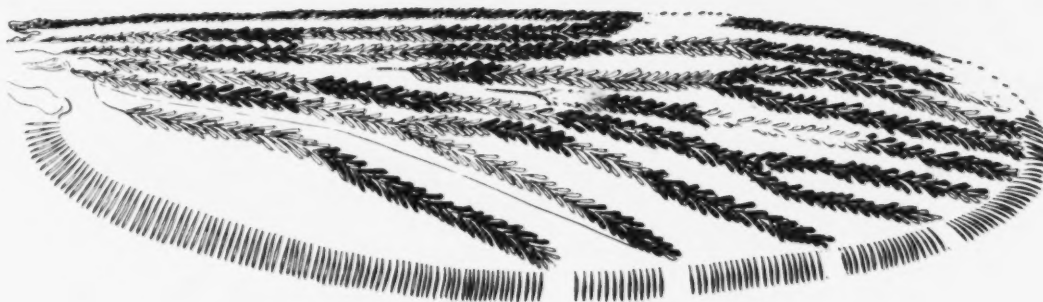
In a few species the wing scales are all dark and rather uniformly distributed so that the wing appears essentially clear as in most culicine mosquitoes. However, most Anopheles have a definite wing pattern with dark spots caused by a clumping of dark wing scales, or patches of dark and pale scales.



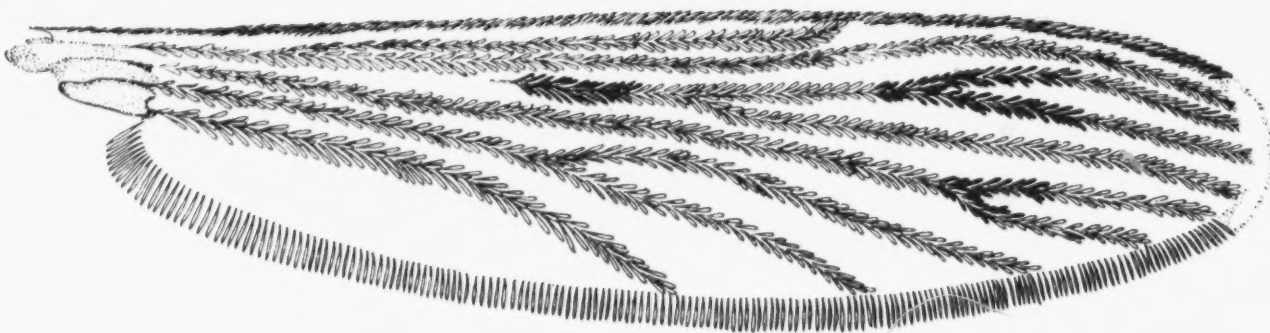
The fringe along the edge of the wing is dark in some species or, dark and pale in others.

TEST YOURSELF: Match one of the numbered statements with one of the lettered drawings.

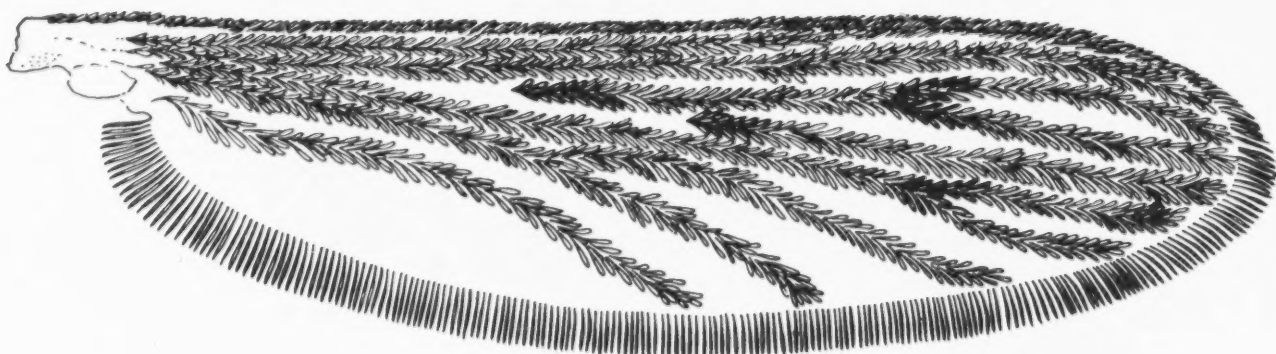
1. The wing fringe is entirely dark in Anopheles quadrimaculatus
2. The wing fringe is alternately pale and dark in Anopheles pseudopunctipennis
3. The wing fringe is dark except at the tip in many species of the Anopheles maculipennis complex.



A _____



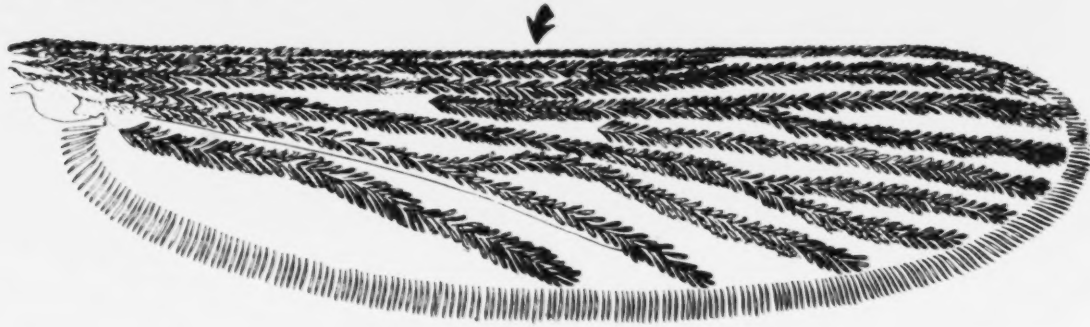
B _____



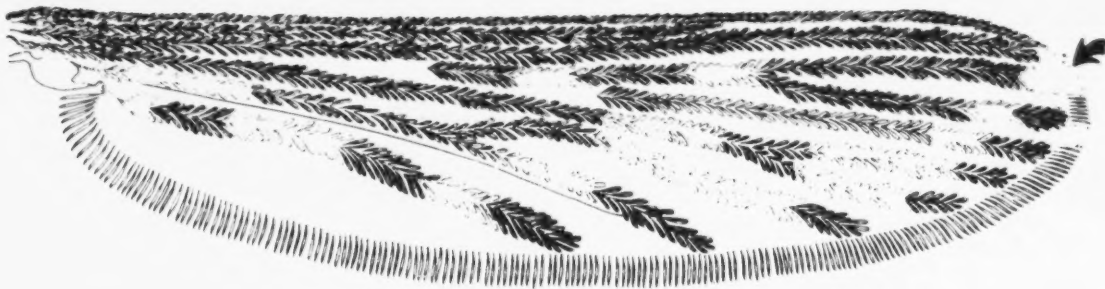
C _____

The coloration of the anterior margin of the wing (costa) offers excellent characters for dividing Anopheles into species groups.

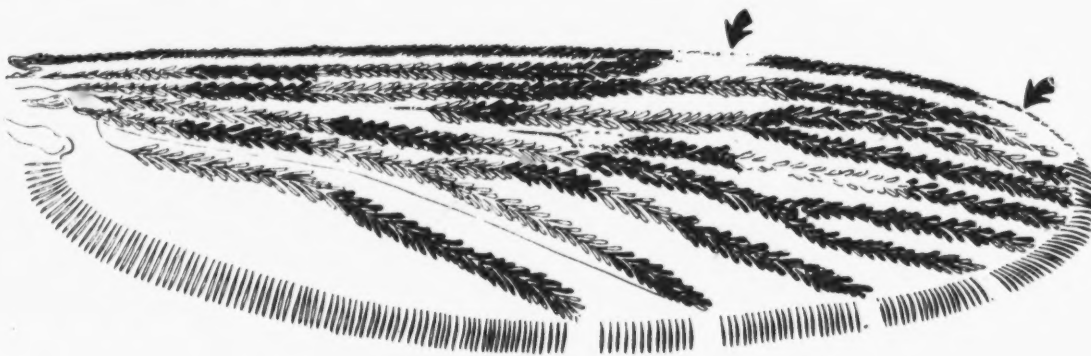
The anterior margin of the wing is entirely dark in Anopheles quadrimaculatus and Anopheles maculipennis and related species.



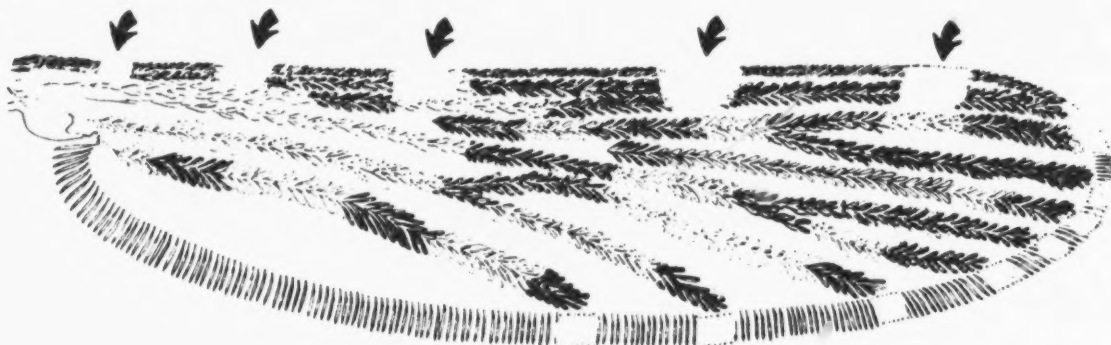
In the Anopheles crucians complex, there is one pale spot at the wing tip.



In the Anopheles pseudopunctipennis group there are two pale spots on the front margin of the wing.



In the Old World subgenus Anopheles (Cellia) most of the species have four or more pale spots on the anterior margin as in Anopheles (Cellia) aconitus.



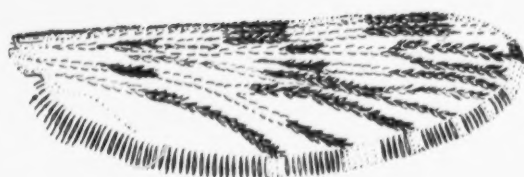
TEST YOURSELF: Wing 1, shows the pattern of dark and light wing scales in Anopheles pseudopunctipennis and Wing 2 the way these same markings may be illustrated diagrammatically with solid lines or narrow boxes. Using a pencil, draw a solid line  for each black spot and a narrow box  for each pale spot to conform to the following statements:

Wing 3, in Anopheles punctimacula there are three large dark areas on the anterior margin of the wing and at least six dark and six pale spots on the sixth vein.

Wing 4, in Anopheles bellator, the second, fourth and sixth veins are completely dark-scaled.

Wing 5, in Anopheles darlingi, on the anterior margin of the wing there are four small white spots on the basal half and two large white spots on the apical half.

Wing 6, in Anopheles albimanus, on the anterior margin of the wing there are four small white spots on the basal half and two large white spots on the apical half; there are two dark spots on the sixth vein.



WING 1



WING 2



WING 3



WING 4



WING 5



WING 6

TEST YOURSELF: Draw a heavy dark line for patches or lines of dark scales  and a narrow box for patches of pale scales , and tiny black lines , or dotted boxes , to indicate dark or pale wing fringe to conform to the following statements:

Wing 1, in Anopheles gambiae there are four pale spots on the anterior margin of the wing. The sixth vein has 3 pale spots and 3 dark spots, with the first pale spot at the base, and the last dark spot at the tip of the vein.

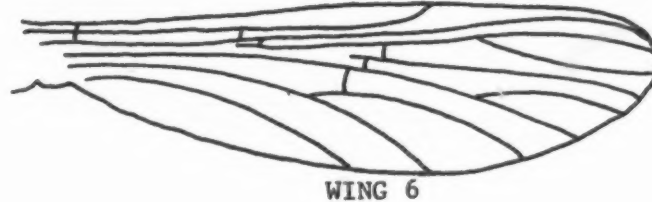
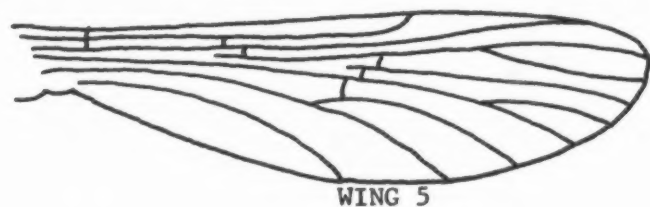
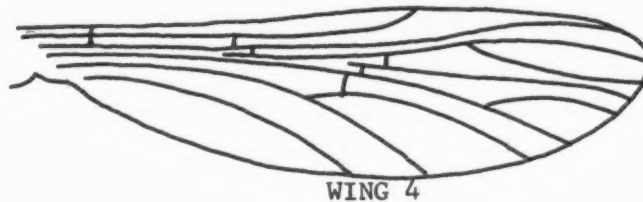
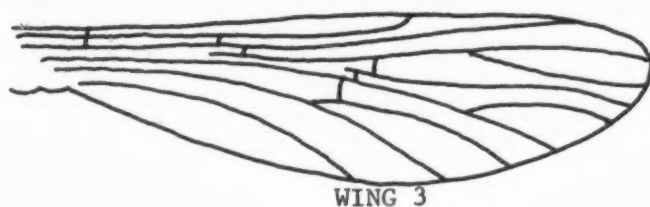
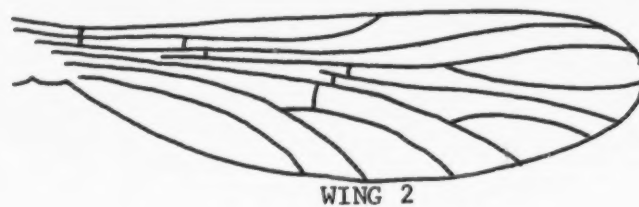
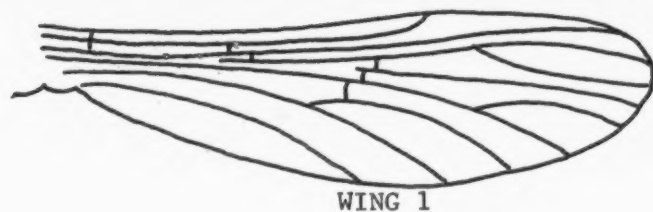
Wing 2, in Anopheles funestus there are four pale spots on the anterior margin of the wing. The sixth vein has the basal half pale and outer half dark.

Wing 3, in Anopheles hyrcanus the anterior margin is dark with a pale spot at the outer third and another just before the tip.

Wing 4, in Anopheles maculipennis the wing scales are all dark except for the pale fringe at the tip of the wing. There are dark spots at the fork of veins 2 and 4 and dark spots on the stem portion of veins 2, 3, and 4.

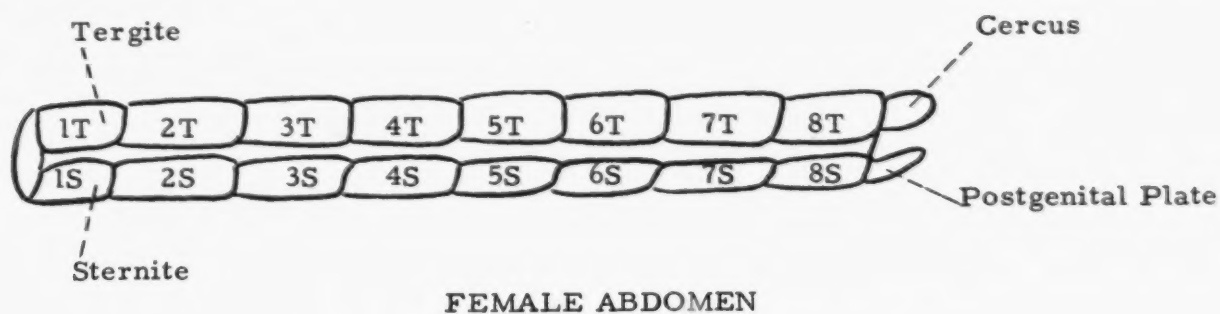
Wing 5, in Anopheles minimus there are four pale spots on the anterior margin; the wing fringe is dark with pale areas at the tips of the first five veins, but dark at the tip of the sixth vein; the sixth vein has a dark base and tip and pale middle portion.

Wing 6, in Anopheles culicifacies there are four pale spots on the anterior margin; the wing fringe is dark except for pale spots at the tip of veins 4.2 and 5.1.

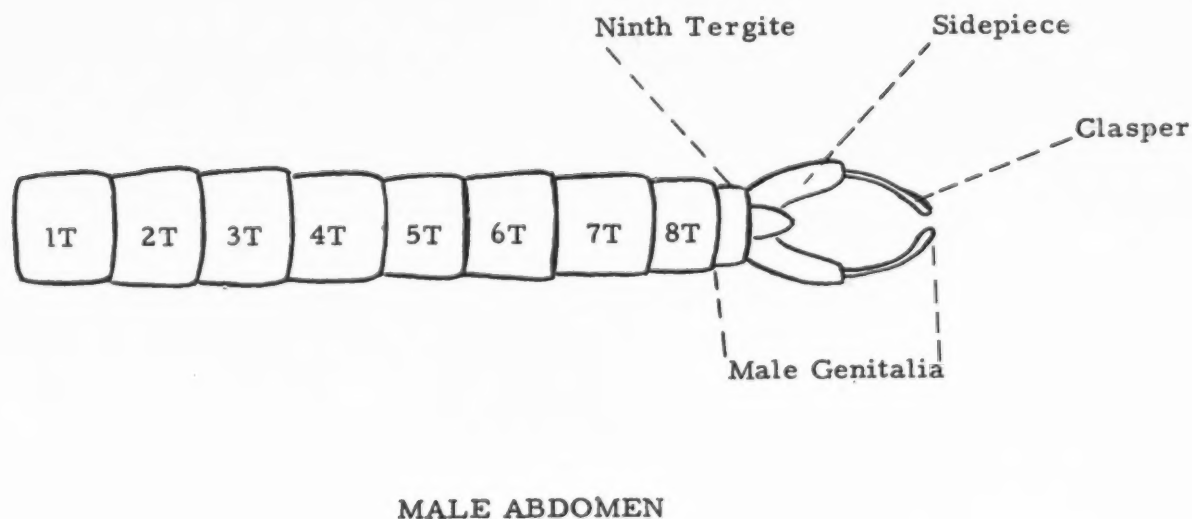


The abdomen of a mosquito is composed of 10 segments and likewise aids in the differentiation. Eight basal segments consist essentially of two plates, a dorsal tergite and a ventral sternite (see drawings). The ninth and tenth segments, which bear the specialized sex structures, afford differentiation between male and female.

The female abdomen is somewhat rounded and bears a pair of cerci (singular cercus) at the tip. In the drawing below, note that the ninth and tenth segments are retracted and do not show.



The male abdomen bears a complex pincer-like structure known collectively as the male genitalia, or the terminalia or hypopygium.



The top (dorsal) side of the abdomen typically is covered only with hairs.



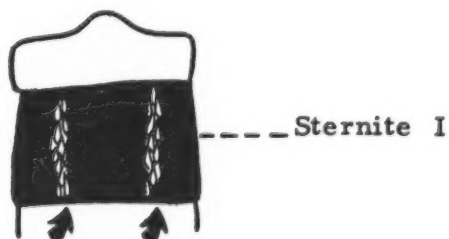
However, in some species, as Anopheles stephensi, there are patches of scales dorsally.



In many species, as Anopheles albitarsis, there are tufts of scales on the sides of the abdomen.



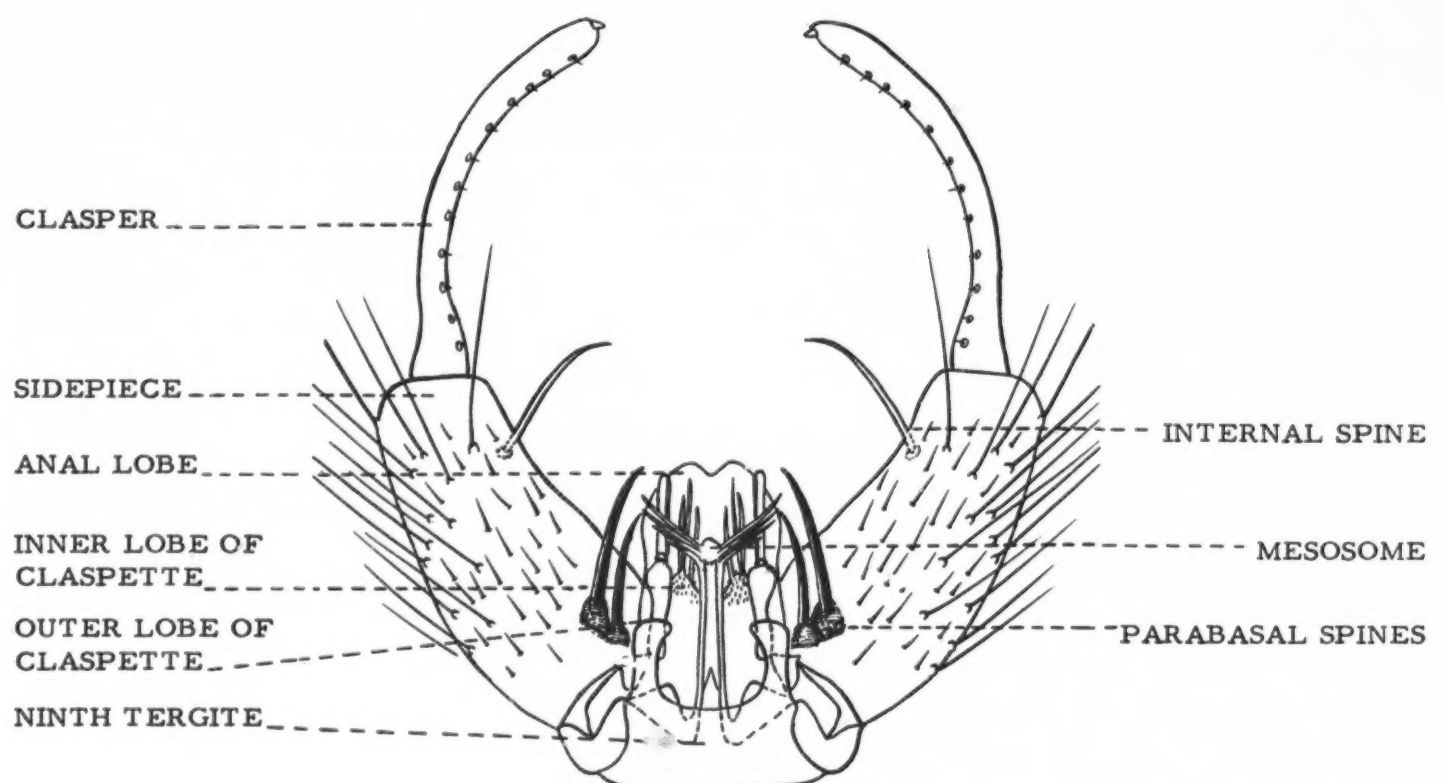
In some species there are lines of scales on the under (ventral) side of the abdomen, as in Anopheles albitarsis.



The male genitalia consist of complicated structures which vary greatly from species to species and therefore have great value in identification.

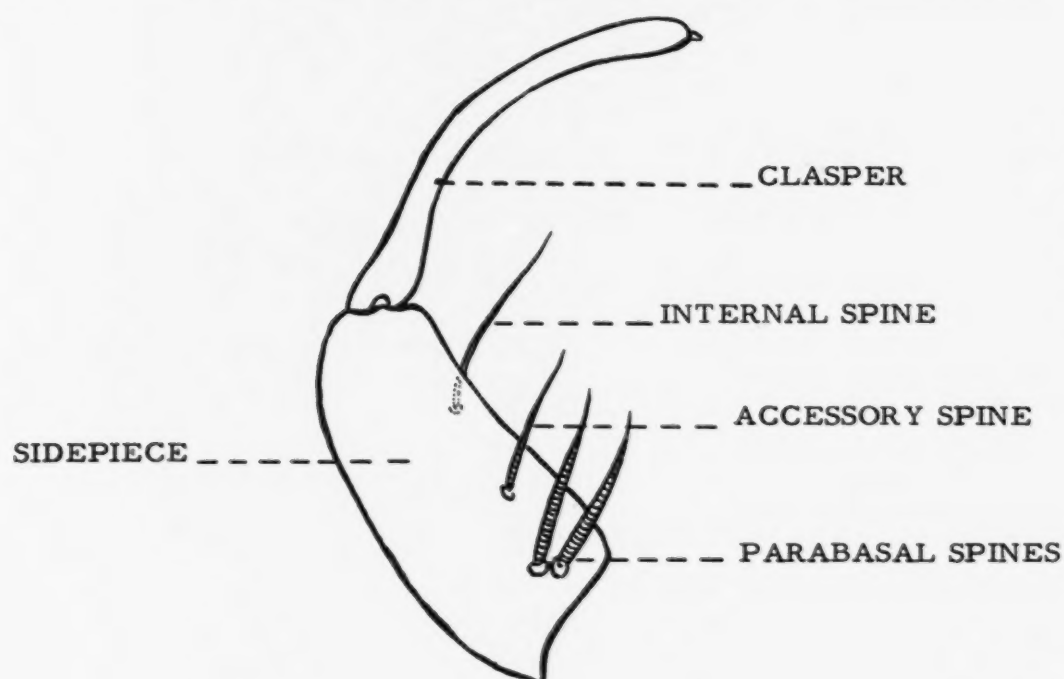
The male genitalia consist of a basal collar-like portion, the ninth tergite bearing two large sidepieces (coxites, basistyle, or basimere) each terminating in a clasper (style, dististyle, distimere). Between the sidepieces lies the triangular anal lobe (proctiger) and the mesosome (phallosome, aedeagus, or penis) shaped somewhat like an inverted Y and often bearing one or more pairs of leaflets at the tip.

On either side of the mesosome are located the claspettes (harpago) which may be divided into outer and inner (ventral) lobes.



MALE GENITALIA

The sidepiece bears the parabasal spines, accessory spines, and internal spine.



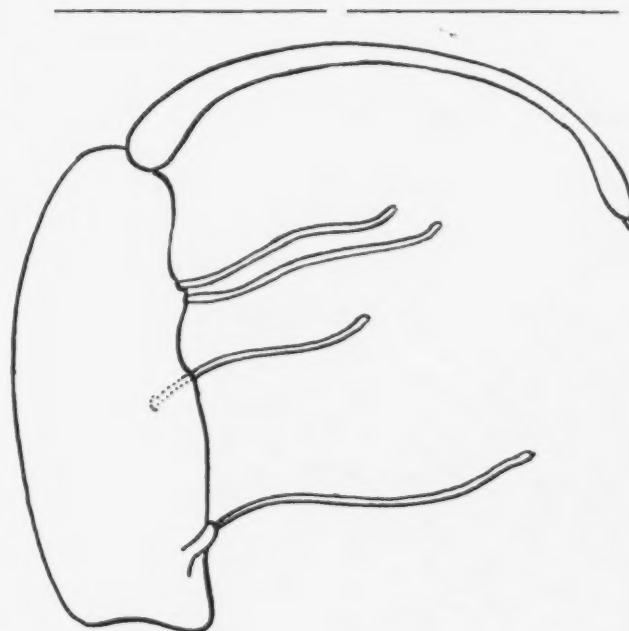
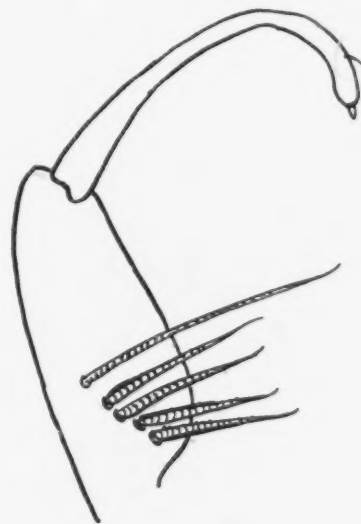
The number and position of these spines is of great value in classification, particularly in dividing the genus Anopheles into smaller groups called subgenera (singular, subgenus).

Classification of Anopheles based on number of spines on side piece.

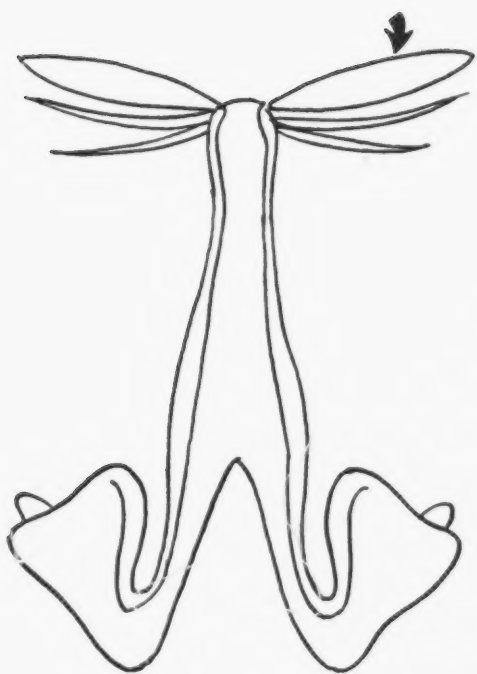
<u>Anopheles</u> subgenus	Parabasal spines	Accessory spines	Internal spine
<u>Anopheles</u>	2	0	1
<u>Nyssorhynchus</u>	1	2	1 (between accessory spines & tip of sidepiece)
<u>Kerteszia</u>	1	2	1 (between parabasal spine & accessory spines)
<u>Stethomyia</u>	1 large	0	1 slender
<u>Cellia</u>	Several		

Write the Genus and Subgenus names beside the drawing corresponding to one of the four following statements:

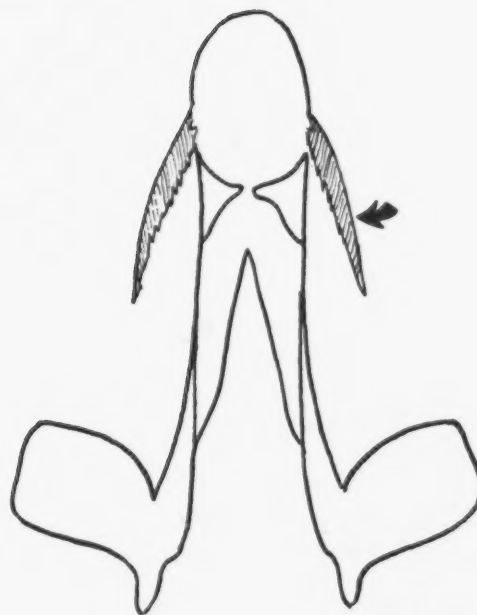
- 1 Anopheles (Anopheles) has 2 parabasal spines, no accessory spines and 1 internal spine.
- 2 Anopheles (Nyssorhynchus) has 1 parabasal spine, 2 accessory spines between parabasal spine and internal spine, and 1 internal spine.
- 3 Anopheles (Kerteszia) has 1 parabasal spine, 2 accessory spines, and 1 internal spine between the parabasal and accessory spines.
- 4 Anopheles (Cellia) typically has several (usually 5) parabasal spines.



The mesosome often bears leaflets at the tip. These are smooth in some species and bear teeth in other species.



ANOPHELES PUNCTIMACULA



ANOPHELES DARLINGI

PART III

Illustrated Key to Some Important Female Anopheles

One of the most important aspects of the world-wide Malaria Eradication Program is the killing of infected Anopheles before they can transmit malaria to uninfected people. Although there are nearly 300 described species of Anopheles, in most areas of the world only one or two species are primary vectors of malaria. An illustrated key to some important female Anopheles mosquitoes is presented in the following pages. Use it to learn the characters necessary to identify the primary vectors in your area.

Harry D. Pratt and Chester J. Stojanovich

-
- A detailed black and white illustration of a large, oval-shaped, textured object, possibly a fossil or a piece of wood. The surface is covered in fine, parallel lines, suggesting a fibrous or layered structure. A small arrow points to a specific feature on the lower left side of the object.

Fig. 1 A

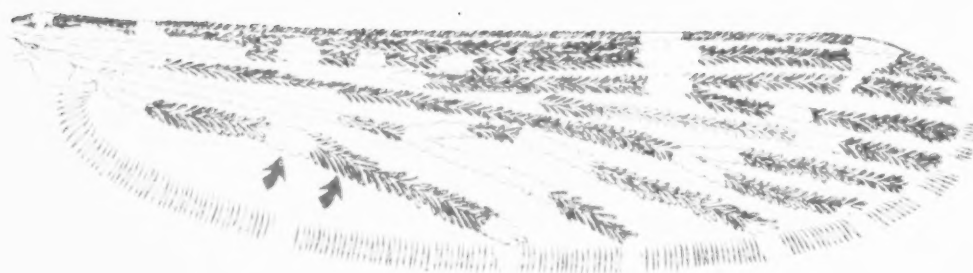


Fig. 1 B

-

Fig. 2 A

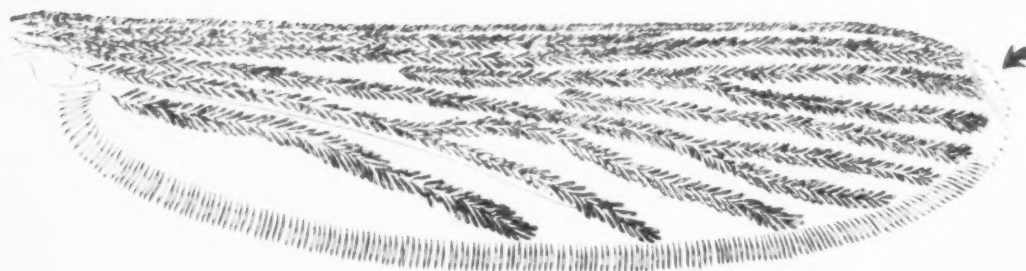


Fig. 2 B

3. Front margin of wing with one or two pale areas (Fig. 3 A).....4
- Front margin of wing with four or more pale spots (Fig. 3 B).....7

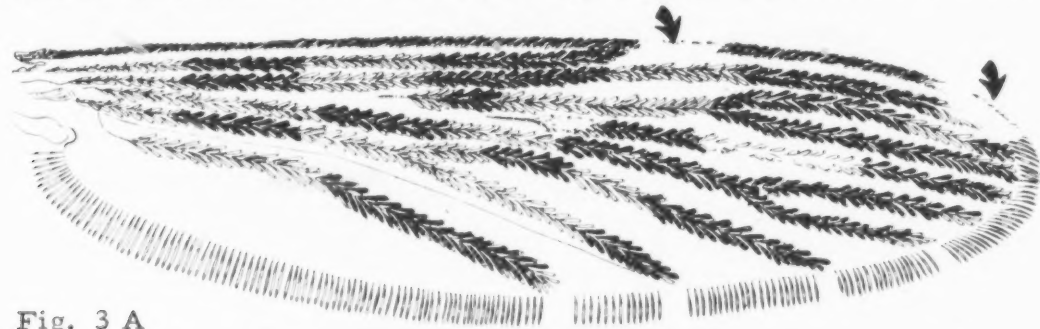


Fig. 3 A

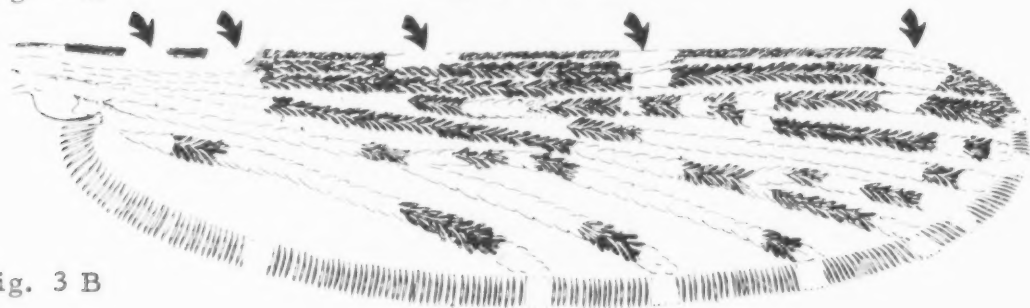


Fig. 3 B

4. Palpi dark (Fig. 4 A)..... 5
- Palpi with dark and pale bands (Fig. 4 B)..... 6

Fig. 4 A



Fig. 4 B



5. Costa with scattered pale scales between base of wing and subcostal pale spot (Fig. 5 A)
..... Anopheles barbirostris (Asia)
- Costa without pale scales (Fig. 5 B)..... Anopheles umbrosus (Asia)

Fig. 5 A

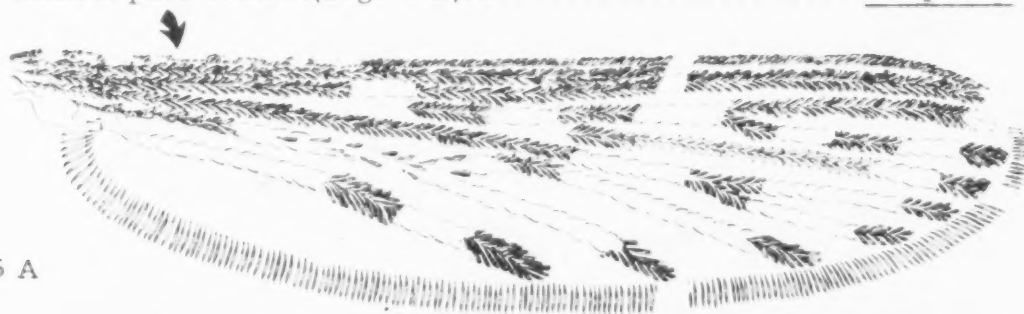
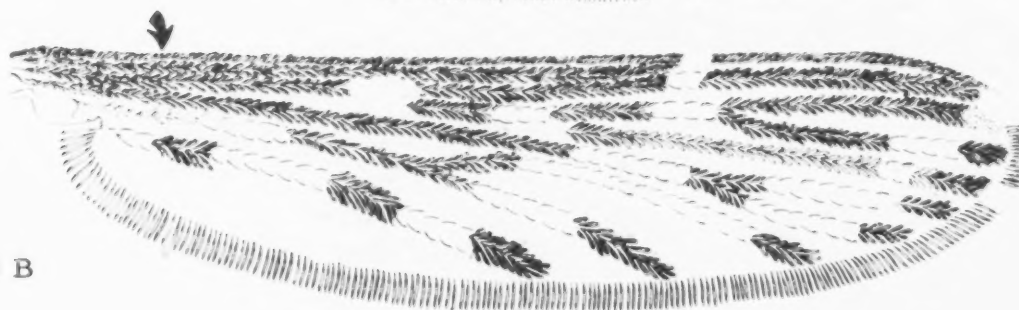


Fig. 5 B



6. Tarsi entirely dark (Fig. 6 A).....
 Anopheles pseudopunctipennis (North, Central and South America)
- Tarsi with narrow pale bands (Fig. 6 B).....
 Anopheles hyrcanus complex (Eurasia and North Africa)



Fig. 6 A



Fig. 6 B

7. Hind tarsal segments 2-5 mostly white, sometimes a small dark ring at base of segment 5 (Fig. 7 A)..... 8
- Hind tarsal segments 2-5 dark, spotted or banded (Fig. 7 B) 11



Fig. 7 A



Fig. 7 B

8. Hind tarsal segment 5 entirely white (Fig. 8 A)..... 9
- Hind tarsal segment 5 with narrow black band at base, tip white (Fig. 8 B)..... 10



Fig. 8 A



Fig. 8 B

9. Abdomen with lateral tufts on segments 2 to 8; no lines of white scales on underside of first sternite (Fig. 9 A & B)..... Anopheles darlingi (South & Central America)
- Abdomen with lateral tufts on segments 3 to 8; 2 lines of white scales on underside of first sternite (Fig. 9 C & D)..... Anopheles albitarsis (South America)



Fig. 9 A

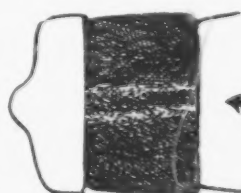


Fig. 9 B

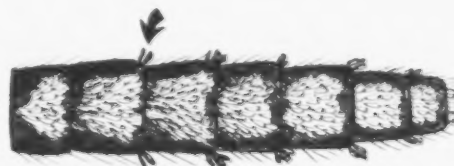


Fig. 9 C

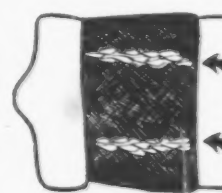


Fig. 9 D

10. Last segment of palpus white (Fig. 10 A).. Anopheles albimanus (Caribbean & South America)
 Last 2 segments of palpus white (Fig. 10 B).....
 Anopheles aquasalis (Caribbean & South America)

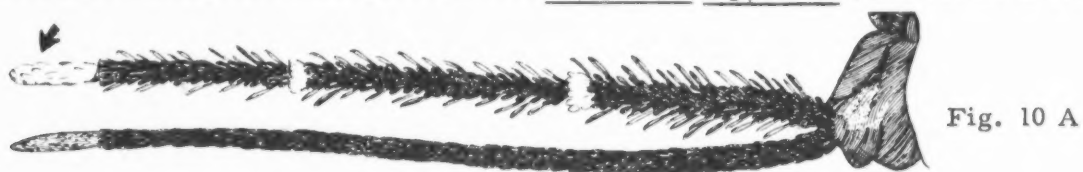


Fig. 10 A



Fig. 10 B

11. Mesonotum with 4 dark lines (Fig. 11 A); veins 4 and 6 entirely dark (Fig. 11 C).....
 Anopheles bellator (Central & South America)
 Mesonotum without 4 dark lines (Fig. 11 B); veins 4 and 6 with black and pale scales
 (Fig. 11 D).....12

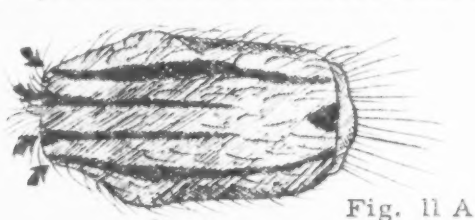


Fig. 11 A

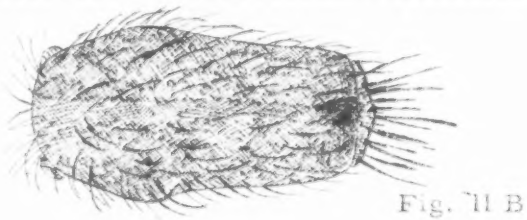


Fig. 11 B

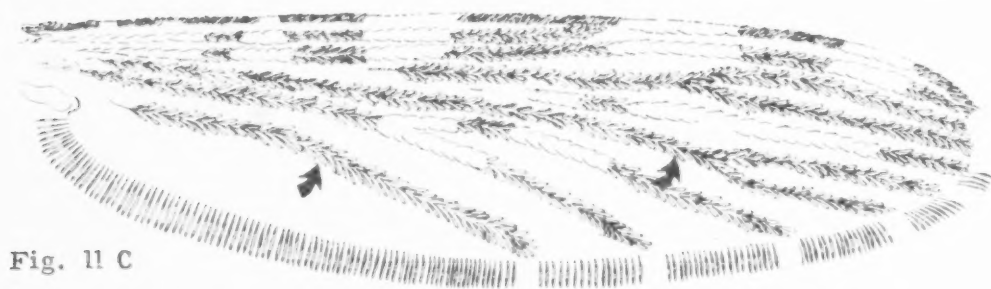


Fig. 11 C

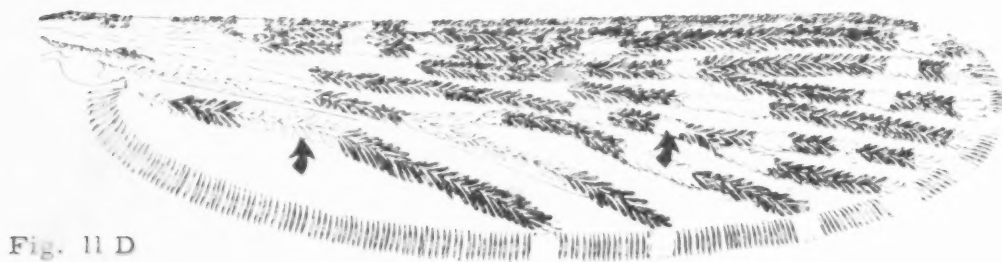


Fig. 11 D

12. Hind femur and tibia speckled with many pale scales (Fig. 12 A)..... 13
 Hind femur and tibia not speckled (Fig. 12 B)..... 20

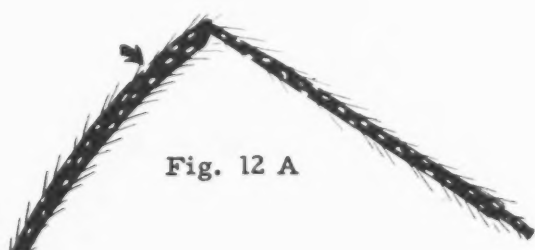


Fig. 12 A

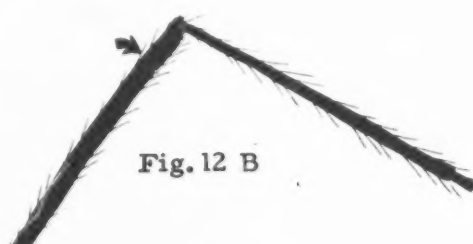
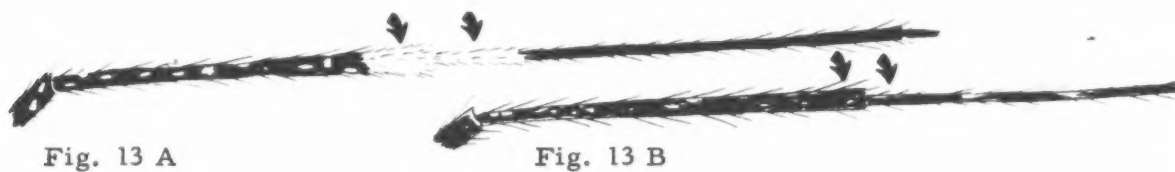


Fig. 12 B

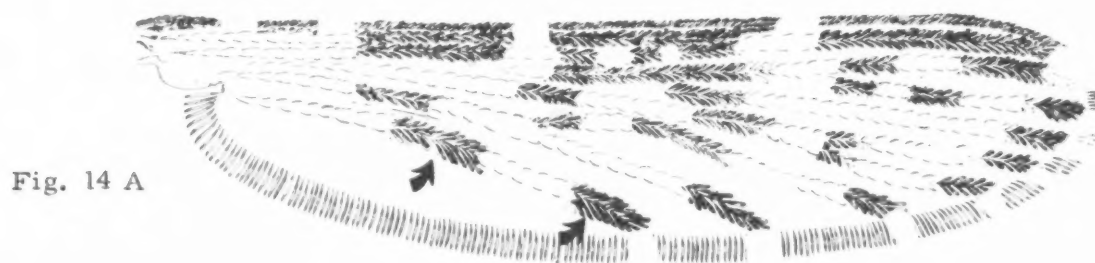
13. Tibio-tarsal joint of hind leg with broad, continuous pale band (Fig. 13 A).....
 Anopheles leucosphyrus group including Anopheles balaobacensis (Asia)

Tibio-tarsal joint of hind leg without broad, continuous, pale band (Fig. 13 B).....14



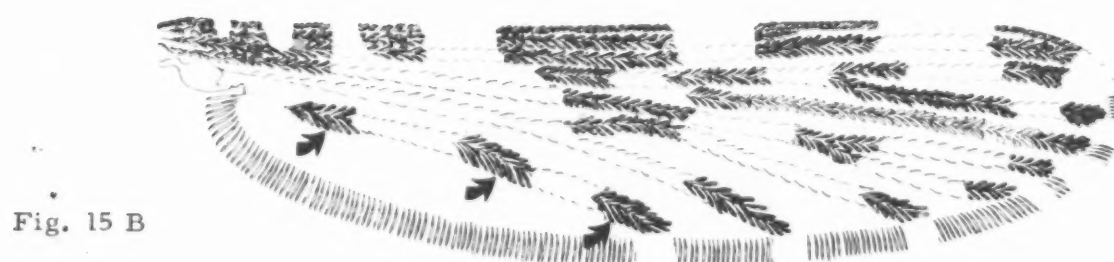
14. Vein 6 with 2 or 3 dark spots (Fig. 14 A)..... 15

Vein 6 with more than 3 dark spots (Fig. 14 B)..... 19



15. Vein 6 with 2 dark spots (Fig. 15 A).....Anopheles sunaicus (Asia)

Vein 6 with 3 dark spots (Fig. 15 B).....16



16. Last segment of hind tarsus entirely white (Fig. 16 A).....17
 Last segment of hind tarsus largely or entirely dark (Fig. 16 B).....18

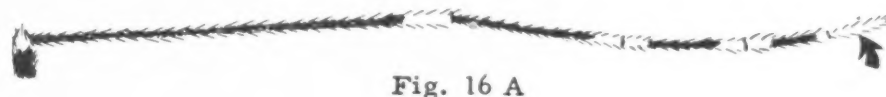


Fig. 16 A



Fig. 16 B

17. Hind tibia with a broad pale band before middle (Fig. 17 A)... Anopheles pharoensis (Africa)
 Hind tibia with many pale spots but no well-defined pale band before middle (Fig. 17 B)....
 Anopheles maculatus (Asia)

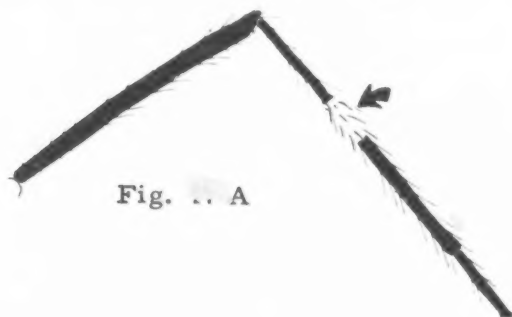


Fig. 17 A

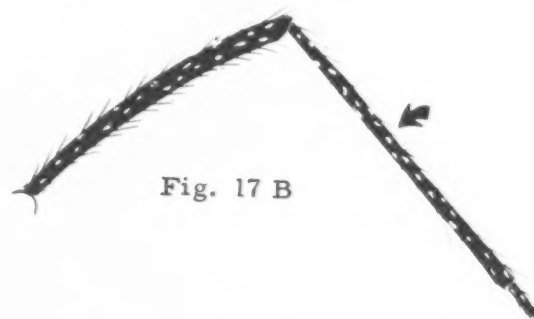


Fig. 17 B

18. Palpus with apical pale band much broader than other pale bands (Fig. 18 A).....
 Anopheles gambiae (Africa)
 Palpus with broad apical and subapical pale bands and narrower basal pale bands (Fig. 18 B)
 Anopheles stephensi (Asia)



Fig. 18 A



Fig. 18 B

19. Palpus with more light scales than dark (Fig. 19 A)..... Anopheles farauti (South Pacific)
 Palpus with more dark scales than light (Fig. 19 B).....
 Anopheles punctimacula (Central & South America)



Fig. 19 A



Fig. 19 B

20. Mesonotum with hairs or hair-like scales; broad scales, if present confined to anterior one-third (Fig. 20 A).....21
- Mesonotum with obvious broad scales (Fig. 20 B).....24

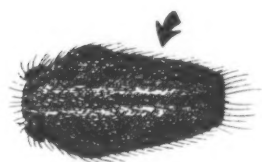


Fig. 20 A

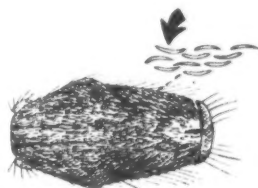


Fig. 20 B

21. Vein 3 mainly dark (Fig. 21 A)..... Anopheles culicifacies (Asia)
- Vein 3 mainly pale (Fig. 21 B).....22

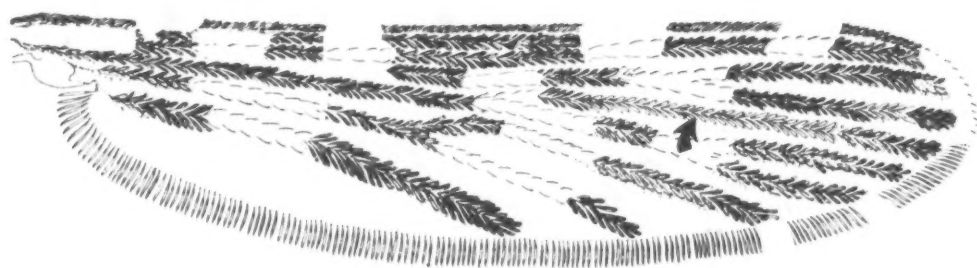


Fig. 21 A

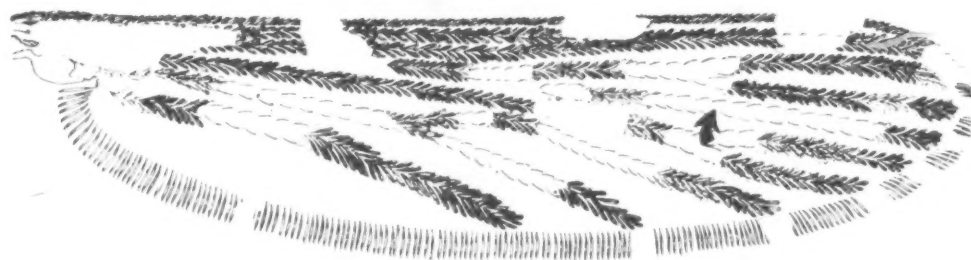


Fig. 21 B

22. Pale fringe spot at tip of vein 6 (Fig. 22 A)..... Anopheles aconitus (Asia)
- No pale fringe spot at tip of vein 6 (Fig. 22 B)..... 23

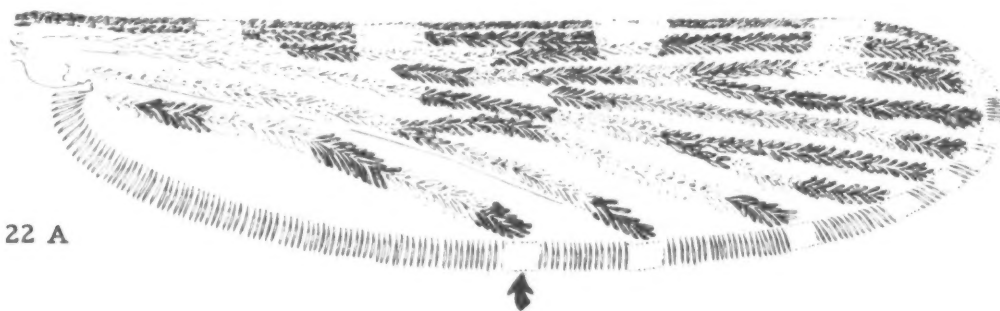


Fig. 22 A

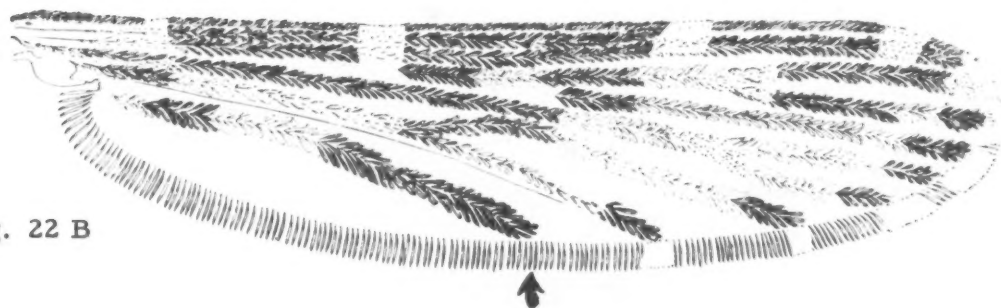


Fig. 22 B

23. Basal third of costa with one or two pale spots (Fig. 23 A)..... Anopheles minimus (Asia)
 Basal third of costa without pale spots (Fig. 23 B)..... Anopheles fluviatilis (Asia)

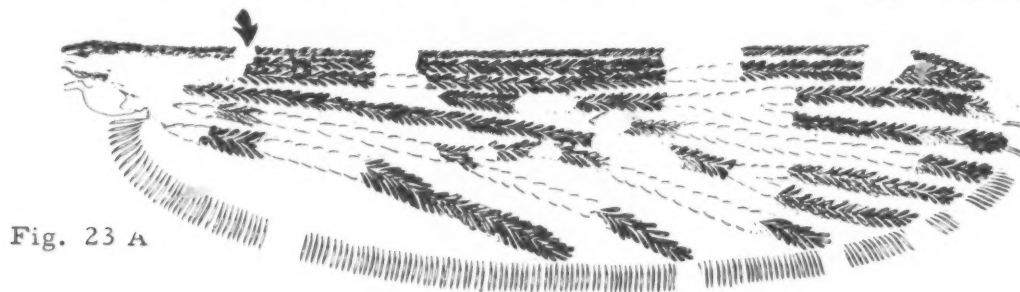


Fig. 23 A

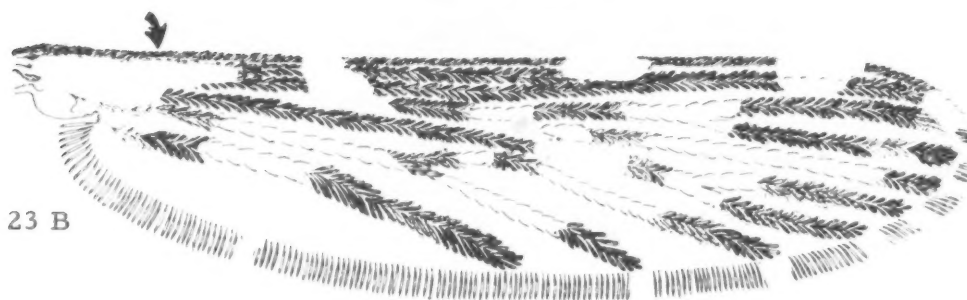


Fig. 23 B

24. A small pale spot at tip of hind femur and tibia (Fig. 24 A)..... Anopheles funestus (Africa)
 Hind femur and tibia entirely dark (Fig. 24 B)..... 25

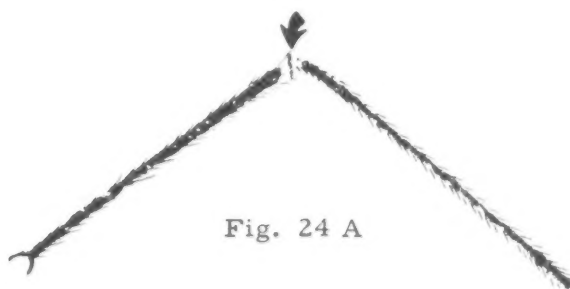


Fig. 24 A

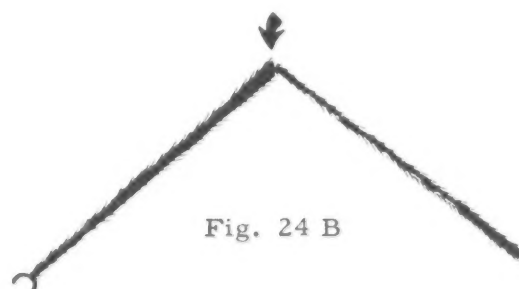


Fig. 24 B

25. Vein 6 with one dark spot on distal half (Fig. 25 A)..... Anopheles superpictus (Eurasia)
 Vein 6 with two dark spots on distal half (Fig. 25 B)..... Anopheles jeyporiensis (Asia)

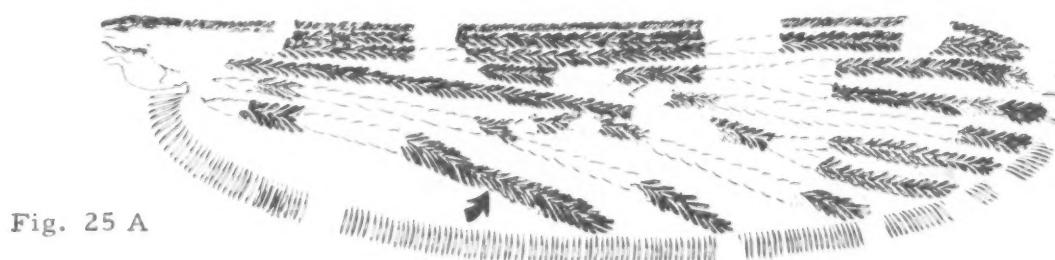


Fig. 25 A

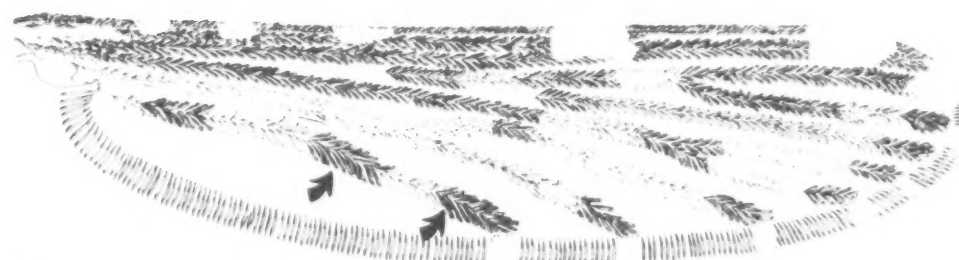


Fig. 25 B

Glossary

- abdomen - the third main body region, p. 13
- accessory spine - a single spine near middle of sidepiece of male genitalia, distad of parabasal spines, p. 42
- anal lobe - a membranous lobe on male genitalia, p. 41
- anopheline - malaria mosquito, from the genus name Anopheles, p. 6, 7
- antenna - the segmented feeler on head, p. 3, 13
(plural antennae)
- cercus - a lobe-like structure at tip of female abdomen, p. 39
- clasper - a movable appendage at tip of sidepiece, p. 39, 41
- claspette - the harpago, p. 41
- clypeus - a rounded prominence on front of head from which the proboscis arises, p. 16
- coxa - the first, or basal, part of the leg, p. 28
- coxite - the sidepiece, p. 41
- culicine - a general term for all non-malaria (non-Anopheles) mosquitoes, from the genus name Culex, p. 6, 7
- dorsal - located on the upper side, p. 39
- eye - the organ of sight, p. 13, 15
- femur - the thickened, third part of the leg, comparable to the thigh, p. 13
- flagellum - the many-segmented distal part of the antenna, p. 3
- fringe - the row of scales on margin of the wing, p. 32
- frontal tuft - a group of setae or scales, or both, on the head, projecting forward between the eyes, p. 16
- genitalia - reproductive parts, p. 39
- halter - the rudimentary hind wing, a club-shaped balancing organ, p. 13
- harpago - claspette, p. 41
- head - the first main body region, p. 15
- hypopygium - the male genitalia, p. 39
- internal spine - a single spine in middle of sidepiece, p. 41, 42, 43
- labellum - the tip of the proboscis, p. 15
- lateral - referring to the side, p. 48

leaflet - a small appendage at tip of mesosome, p. 41, 43
 leg - one of six appendages of the thorax, used for walking, p. 28
 mesepimeral bristles - bristles on the mesepimeron, p. 25
 mesonotum - the top side of the mesothorax, or middle part of the thorax, p. 13
 mesosome - the phallosome or penis, p. 41
 metanotum - the top side of the metathorax, p. 24
 occiput - the part of the head behind the vertex, p. 13
 palpus - a five-segmented structure arising on the head on each side of the base (plural palpi) of the proboscis, p. 6, 7, 13
 parabasal spine - one of a pair or group of spines at the base of the sidepiece, p. 41
 phallosome - mesosome or penis, p. 41
 postnotum - a rounded sclerite between the base of abdomen and the scutellum, p. 13
 prealar bristles - bristles beneath the base of the wing, p. 25
 proboscis - the elongate structure for sucking blood or other fluids on anterior part of head, p. 2, 13
 pronotal bristles - bristles on the two lobes of the top of the prothorax or on the pronotal lobes, p. 25
 pronotal lobe - a rounded lobe of the pronotum, arising above base of the first leg, p. 25
 pronotum - the top side of the prothorax, or first segment of the thorax, p. 24
 propleural bristles - bristles on the side of the prothorax, p. 25
 propleuron - the side of the prothorax, p. 25
 scale - a small, thin plate occurring on the body surface or wing, p. 3
 scape - the small basal segment of the antenna, often hidden by the large globular torus, p. 3
 scutellum - a straplike plate posterior to the mesonotum, p. 13
 sidepiece - one of a pair of large movable structures on either side of mesosome of male genitalia, p. 41
 spiracular bristles - bristles on a triangular plate in front of the spiracle, p. 25
 sternite - the ventral plate of the abdomen, p. 34
 sternopleural bristles - bristles on the large ventro-lateral plate of the thorax, p. 25
 tarsus - the fifth or last part of the leg, 5-segmented in mosquitoes, p. 13, 28
 tergite - a dorsal plate of the abdomen, p. 39